THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1715.] LONDON, MARCH 24, 1896. [48TH YEAR. PRICE 6d.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

Lanemark Coal Co., LIMITED.

LANEMARK CANNEL AND GAS COALS.

Quotations and Analysis on Application to

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Shipping Ports: All the principal Scotch Ports.

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Manufacturers & Contractors.

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT, Parker's Imperial Black Varnish,

Oxide Paints, Oils, and General Stores for Gas and Water Works.

WORKS:

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Specially distil Carburine Spirit, specific gravity ·680, or of any other grade suitable for Enriching Gas; also Gas Oil best adapted for injecting into the Retorts, as in the Herring Process.

Importers of Petroleum for Carburetting Water Gas, or for Manufacturing Oil Gas. Distillers of Pentane, Petroleum Ether, and Naphtha for clearing the pipes of Naphthaline, &c.

Samples and Prices may be had on application.

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DANIEL HOWARD,

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GASHOLDER & BOILER WORKS,

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Wrought-Iron Roofs, Bridges, Girders, &c.,

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EDWARD COCKEY & SONS, LIMITED,

ENGINEERS & CONTRACTORS FOR GAS-WORKS.

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Messrs. COCKEY desire to draw the attention of Gas Engineers and Managers to their new form of GAS WASHER, which, by a recent patent, converts their HORIZONTAL Washer into one of a VERTICAL form.

The principle is the same as in the horizontal one, which has now been before the profession for a number of years, and where adopted is giving unqualified satisfaction.

The Washer is entirely automatic in its action, and does not therefore need any motive power—an advantage which will be apparent to all.

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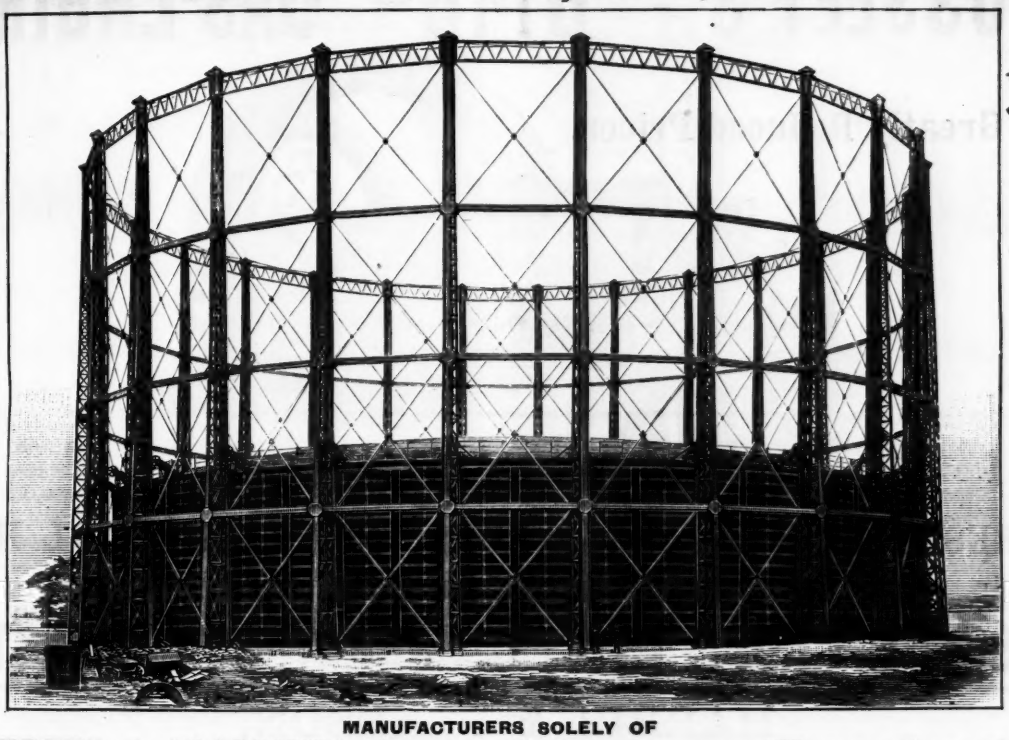

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— HAS ALREADY BEEN SUPPLIED TO GAS-WORKS AT —

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Inquiries to be sent to the Patentees: 9, VICTORIA STREET, LONDON, S.W.

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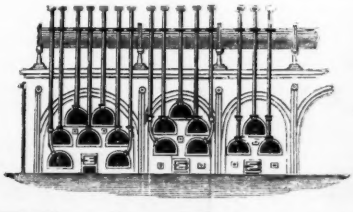

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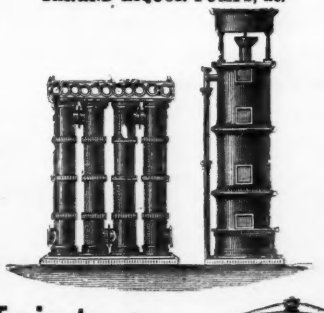

PATENT

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for working Purifiers,

Also Bye-Pass & Stop Valves.

PURIFIERS with Planed Joints,

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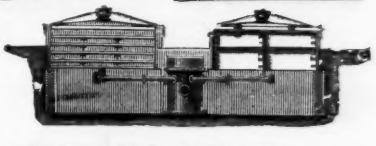

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Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

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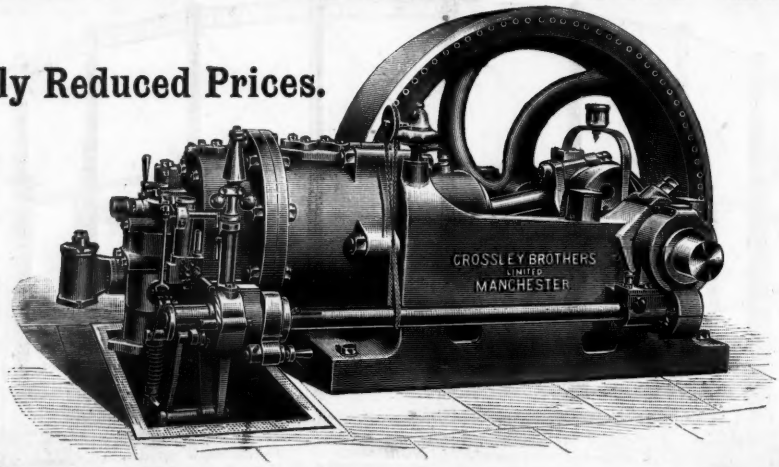

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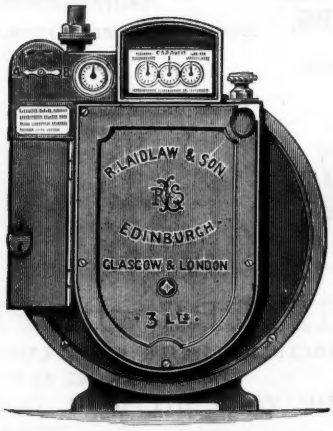
—DRY METER.—



—WET METER.—

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INCANDESCENT GAS-LIGHT

(Welsbach Patents).

Further Great Reduction in Prices,

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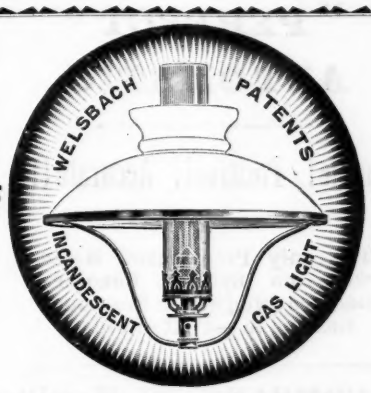
Due to Colossal Sales,

Places this highly popular Light within the means of all classes.

The greatly Reduced Consumption of Gas COVERS THE INITIAL COST OF THE BURNERS IN FROM SIX TO EIGHT MONTHS.



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Prices of other Patterns reduced proportionately.

SPECIAL ATTENTION IS CALLED TO THE

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Which, with a Consumption of 2¼ Cubic Feet of Gas an hour, gives a light of 25 to 30 Candle Power.

This Pattern is particularly recommended where it is desired to effect a large saving in Gas rather than to effect a great increase in the Light.

The attention of Gas Managers and Gas Engineers is called to this System of Lighting as one which tends to Popularize the use of Gas as an Illuminant, owing to the following Advantages—

ECONOMY IN CONSUMPTION OF GAS, COMBINED WITH HIGH ILLUMINATING EFFICIENCY.

FREEDOM FROM SMOKE, DIRT, AND FLICKERING.

GREATLY REDUCED HEAT.

The *Lancet* Special Analytical and Sanitary Commission, in an exhaustive report, pronounces the Incandescent Gas-Light System to be the Healthiest, Best, and most Economical System of Gas Lighting.

SUITABLE FOR EVERY PURPOSE OF INSIDE OR OUTSIDE LIGHTING.

For further Particulars, apply to

The INCANDESCENT GAS-LIGHT CO., LIMITED,

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Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

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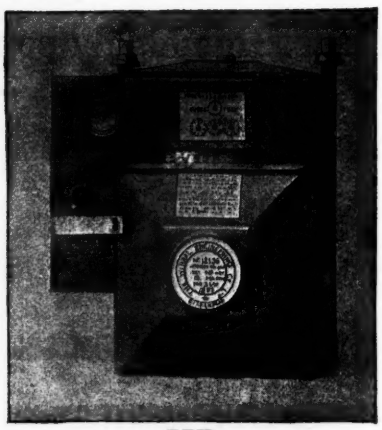
Patent New Prepayment Meters.

WET.

THE "PERFECT" AUTOMATIC.

Simple! Positive!! Accurate!!!

The only Prepayment Meter with no Springs, Counter-Balance Weights, or Frictional Gearing to get out of order.



DRY.

Particulars on Application to the COMPANY, 76, Hamilton Street, BIRKENHEAD.

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Aberdovey	Chesterton
Abergavenny	Clitheroe
Airedale	Cobham
Aldridge	Coleshill
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Ascot	Colney Hatch
Aylsham	Coventry
Ballymena	Cranbrook
Beaumaris	Cullen
Bentham	Deddington
Bewdley	Dewsbury
Bideford	Downpatrick
Birmingham	Dursley
Blackburn	East Ardsley
Bognor	Eastbourne
Bollington	Elland
Boreham	Ellesmere
Bramham	Elstree
Brandon	Eye
Bridgnorth	Farnham
Broadgreen	Felixstowe
Broadstairs	Garston
Bromsgrove	Gillingham
Broughty Ferry	Gorey
Builth	Halesowen
Burton	Hanley
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Cannock	Hinckley
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PAINTS FOR GAS-WORKS. PAINTS FOR GASHOLDERS.

Contractors to Her Majesty's Government, the Indian Government, the Natal Government, the Turkish Government, the Netherlands Railway, the London County Council, &c., &c.

CROSBIE'S PAINTS.

Guaranteed genuine and free from adulteration, and specially made to withstand Gaseous Fumes.

Catalogue and Testimonials on Application.

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COLOUR WORKS, WOLVERHAMPTON.

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Hythe	Roscommon
Ilkeston	Rugeley
Irthlingboro'	Scarborough
Johannesburg	Seaham Harbour
Kegworth	Seisdon
Kilrush	Shifnal
Kildwick	Shipston-on-Stour
Kirkburton	Sidmouth
Knutsford	Skibbereen
Leamington	Slough
Ledbury	Southam
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London	Strood
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Lymington	Swinton
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North Middlesex	Tokio
Outlane	Uppingham
Pembroke	Uttoxeter
Penmaenmawr	Ventnor
Portadown	Warwick
Port Elizabeth	Wexford
Portrush	Wigston
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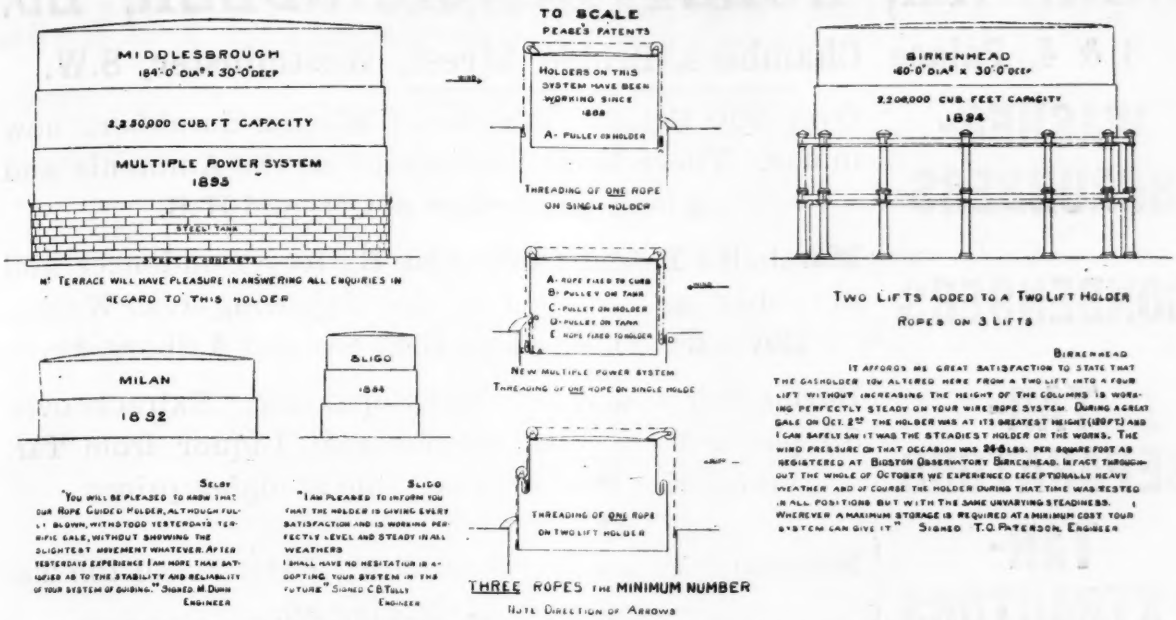
Raunds	Wolverhampton
Richmond	Workington

DIAGRAMS ILLUSTRATING REPRESENTATIVE
ROPE GASHOLDERS



Mr TERRACE WILL HAVE PLEASURE IN ANSWERING ALL ENQUIRIES IN REGARD TO THIS HOLDER

SELBY

"You will be pleased to know that our Rope Guided Holder, although fully blown, withstood yesterday's terrific gale, without showing the slightest movement whatever. After yesterday's experience I am more than satisfied as to the stability and reliability of your system of guiding." Signed M. Dunn Engineer

SLIGO

"I am pleased to inform you that the holder is giving every satisfaction and is working perfectly level and steady in all weathers. I shall have no hesitation in adopting your system in the future." Signed C.B. Tully Engineer

BIRKENHEAD

It affords me great satisfaction to state that the gasholder you altered here from a two lift into a four lift without increasing the height of the columns is working perfectly steady on your wire rope system. During a great gale on Oct. 2nd the holder was at its greatest height (180ft.) and I can safely say it was the steadiest holder on the works. The wind pressure on that occasion was 24 lbs. per square foot as registered at Bidston Observatory Birkenhead. In fact throughout the whole of October we experienced exceptionally heavy weather and of course the holder during that time was tested in all positions but with the same unvarying steadiness. Wherever a maximum storage is required at a minimum cost your system can give it." Signed T.O. Paterson, Engineer

THESE HOLDERS ARE CONSPICUOUS FOR STEADY AND LEVEL WORKING UNDER ALL CONDITIONS, THEY WORK WITH MUCH LESS FRICTION AND IRREGULARITY IN A GALE OF WIND THAN GASHOLDERS WITH COLUMNS, AND ARE ALWAYS STEADY.

ASHMORE BENSON PEASE & Cº Lª.

GAS WORKS CONTRACTORS

STOCKTON-ON-TEES

LATEST

Improvements in Sulphate of Ammonia Apparatus

(COLSON'S PATENT)

EXTRACT FROM ENGINEER'S REPORT—

"I can now obtain **60** Tons of Sulphate of Ammonia per week with 'Colson's' Still, using ONE Boiler, whereas, with my former continuous plant, TWO Boilers were required to produce **40** Tons per week."

For Prices and Particulars, apply to the Sole Makers—

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Gas-Works Contractors, STOCKTON-ON-TEES.

MOBBERLEY & PERRY
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Manufacture & supply best quality of

Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)

Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.

FIRE BRICKS, LUMPS, & TILES, BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c, &c.

EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.

Contractors for the erection of Retort-Benches complete.

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WASHER-SCRUBBERS — Over 500 Patent "Standard" Washer-Scrubbers now in use. These Machines extract all the Ammonia and a large proportion of CO_2 and H_2S.

CONDENSERS — Marshall's Patent Combined Battery Condenser and Scrubber, as supplied to the following Gas-Works: Coventry (3), Randers, Elsinore, and Aalborg, &c.

TAR-SEPARATORS — Burmeister and Wain's Tar-Separator. Extracts over 99 per cent. of the Ammoniacal Liquor from Tar, rendering the latter saleable at higher prices.

TAR-EXTRACTORS — Marshall's Patent Tar-Extractor. Extracts all the Tar without choking up.

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Prices, &c., on application to the above.

THE GAS-METER COMPANY, LIMITED,

MANUFACTURERS OF

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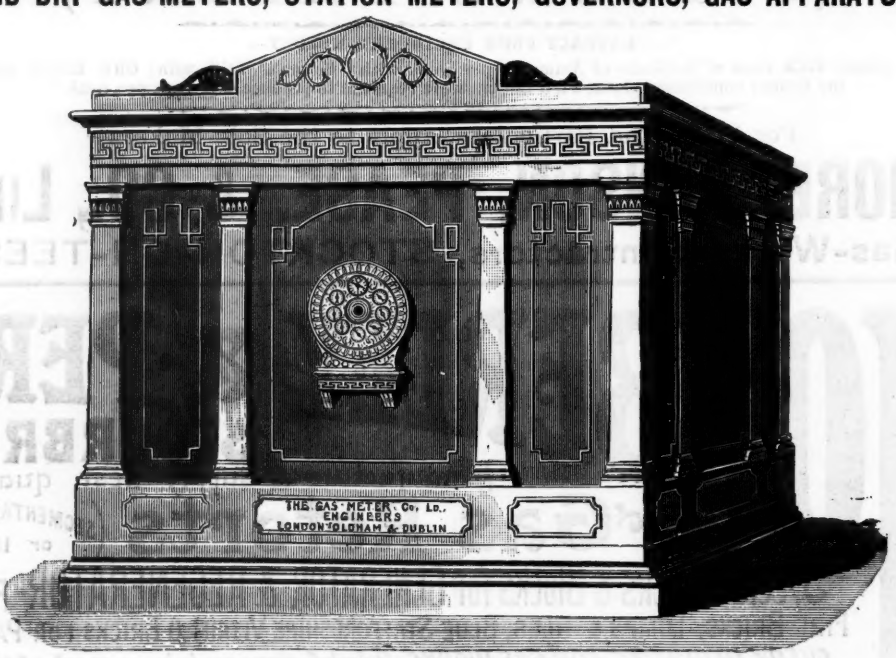
SQUARE STATION METERS WITH PLANED JOINTS.



STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM, Late WEST & GREGSON. Established 1830.

For Prices and **Particulars apply to**

R. L. ANDREWS, General Manager.

Works: 238, KINGSLAND ROAD, LONDON; UNION STREET, OLDHAM; HANOVER STREET, DUBLIN.

Telegraphic Address: "METER."

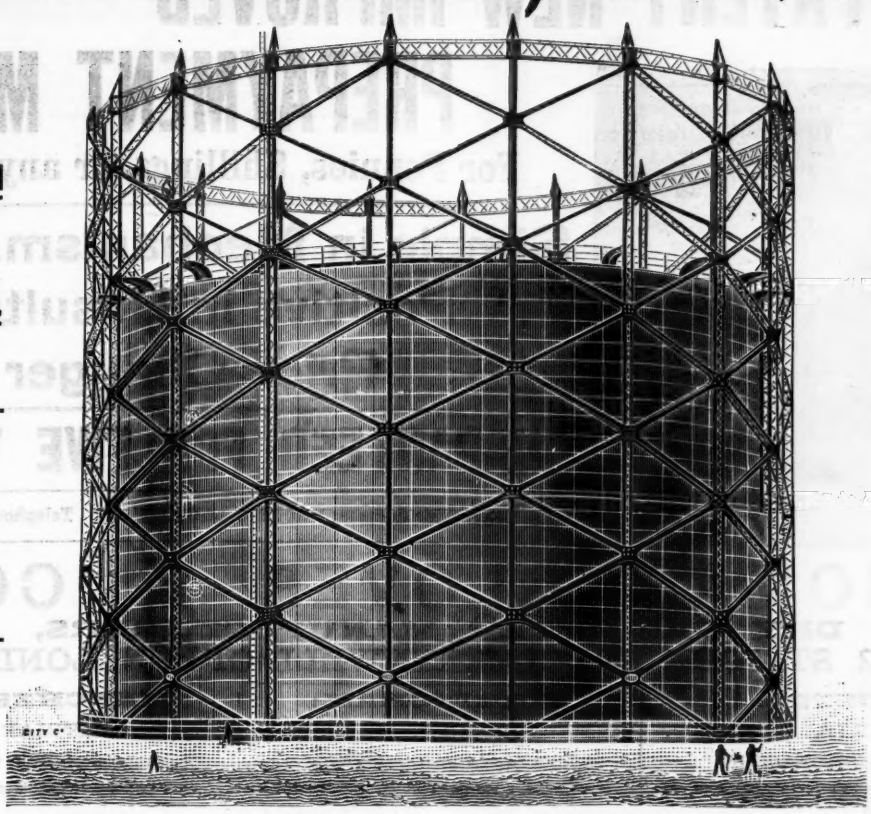
[See Advertisement on back of Wrapper.

S. CUTLER & SONS, MILLWALL, LONDON

BEST POSSIBLE DISPOSITION OF MATERIALS.

SAFE.

CHEAP.



SAVING IN COST OF TANK AS No Piers ARE Required.

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GASHOLDERS OF EVERY DESCRIPTION.

THE FOLLOWING ARE A FEW EXAMPLES OF LARGE HOLDERS RECENTLY ERECTED—

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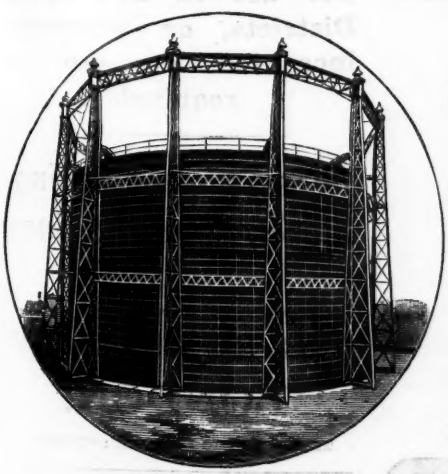
Bethnal Green .	3-lift	197 „ 50	Do. . .	2-lift	160 „ 37	West Ham . . .	2-lift	150 „ 36
Birmingham (2)	3-lift	236 „ 50	Copenhagen. .	3-lift	175 „ 30	Derby	2-lift	140 „ 26
Vienna . . .	3-lift	204 „ 41	Hull	3-lift	160 „ 37	Rochdale. . . .	4-lift	150 „ 34
Dublin . . .	2-lift	201 „ 40	Portsea . . .	3-lift	158 „ 30	Tottenham . . .	3-lift	150 „ 32
Berlin. . . .	3-lift	181 „ 35	Hanover . . .	3-lift	154 „ 38	Sunderland. . .	3-lift	150 „ 32

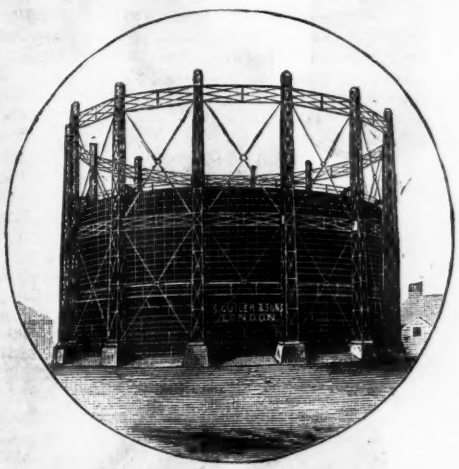


STEEL TANKS FOR GASHOLDERS.

CUTLER'S PATENT

Freezing Preventer

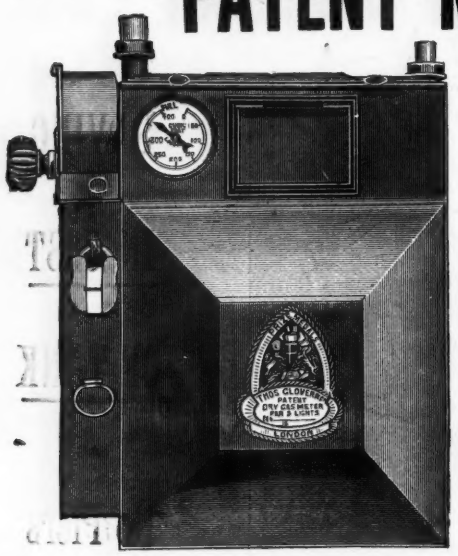
SHOULD BE FITTED TO ALL GASHOLDER CUPS.



MANUFACTURERS OF CARBURETTED WATER-GAS PLANT.

Designs and Estimates upon Application.

THOMAS GLOVER & CO.'S
PATENT NEW IMPROVED
PREPAYMENT METER



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Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

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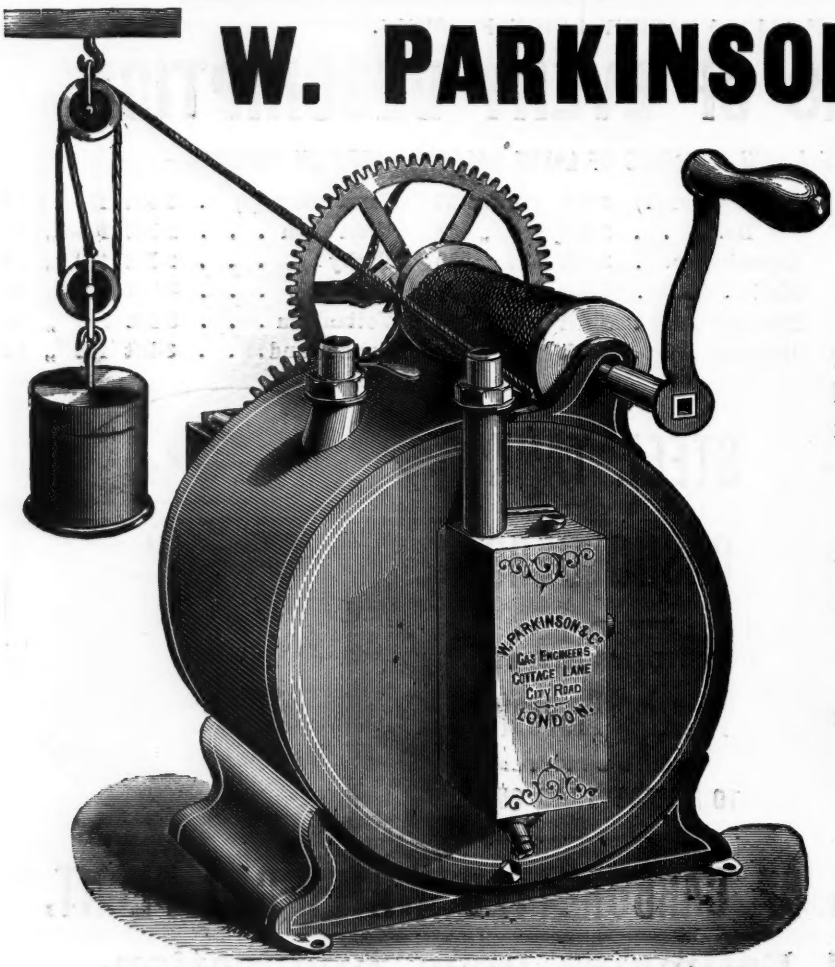

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EDITORIAL NOTES.

Bimetallism.

On several occasions, the question of bimetallism and the various problems allied to this general controversy have been mentioned in this column. Gas supply is an enterprise which is carried on in "silver" as well as in "gold" countries; and the factor of exchange is one of the elements which enter into the problem of profit-making as it is presented to many a gas manager. It is, in truth, only when one has had to grapple with this factor in the course of ordinary business that the ability to take a serious interest in currency questions is created. The "gentlemen of England, who live at home at ease," have no conception of what it means to have to measure every commodity by a shifting standard of value. Yet this is precisely the problem which underlies all commercial questions over a wide area of the earth's surface. Apparently, it is also a condition of existence that a number of worthy and otherwise sane inhabitants of the British Isles wish to import for home experience. What else does bimetallism mean? At any rate, whosoever wishes to know what can be said upon this subject, by way of alternative answer to our query, may be recommended to peruse the report of last Tuesday's debate in the House of Commons, when the Chancellor of the Exchequer showed pretty conclusively, to anybody who is not a fanatic, why the case of the bimetallists cannot commend itself to the sense of the British Parliament. Plain men may be pardoned for experiencing difficulty in understanding how a measure of exchange, or a system of currency, can have any connection with the intrinsic value of commodities. One would quite naturally suppose the operation of supply and demand competent enough to fix the value of anything marketable, whatever the nature of the medium in terms of which this value may be expressed. Thus a man gives so much labour in exchange for the price of a sheep. Originally, perhaps, the actual labour was recompensed by the actual animal; but the world has long since found it more convenient to interpose in the course of all such bargains a common standard of value, which is called "money." How anything in the money itself is to compel a man to work harder for his sheep, or to supply him with the sheep as a reward for a lessened amount of toil, does not appear in the nature of these things.

The bimetallists seem to hold that there is something in money, apart from its exchangeable value. They appear to hold that when money changes hands, it also, in some way, changes in value; and they declare that gold, for instance, has "appreciated" in value, because more can be bought with it than was formerly the case. This argument, as the Chancellor of the Exchequer justly observed, would be at least intelligible if it were borne out by the facts. If a sovereign would buy more of everything now than it did (say) twenty years ago, one might see that it had attained a higher value—in other words, that it had become appreciated. The fact, however, is altogether different. While some commodities, such as wheat, wool, and meat, are cheaper as measured by the gold standard, many other things, such as good investments, are considerably dearer. If a man goes into the market to buy a perpetual income of a pound a year, he is bent upon a commercial transaction as fully as when he sets out to buy a loaf of bread. Yet whereas in the one case he can get cheaper bread, or more bread for a stated amount of money, than was ever before obtainable since bread was first sold in the market-place, he must in the other case pay a higher rate for his fixed income than has ever been found necessary in the history of the world's finance. What, therefore, becomes of "appreciation of gold" between these examples? It simply does not exist, save as a phantasy.

The truth of the matter is that civilized and educated men are still as little prepared by their ordinary training as the untutored savage to perceive the operation of natural forces in the concrete effects that strike their consciousness. The world has been at peace, more or less, for a quarter of a century; and during this time, means of cultivation, manufacture, carriage, and distribution of the necessaries of life have been more developed, and pushed farther than ever before in different parts of the world. The average man knows this, in a vague sort of way, as he knows most things that do not very closely

concern himself. But when he sees an actual effect of these and other deep-seated, wide-spreading influences, he does not at first recognize it for what it is. Sometimes he is driven to fall back upon the supposition that it is the nature of the coinage he spends upon his purchases which affects their value. Just as well might the agriculturist regard the material of which his implements of husbandry are made as competent to affect the prospects of the harvest. Meanwhile, the average man of business will probably continue to act as though his first duty consisted in getting possession of as many sovereigns as possible; leaving it to subsequent inquiry to ascertain how to test them for appreciation or the reverse.

Gas Legislation in Parliament.

Progress was made last week with several Gas Bills. A House of Lords Committee considered the Bill promoted by the Newcastle and Gateshead Gas Company, which was opposed by the Corporations of the two towns, chiefly on points of detail. The Company agreed to raise their loan capital to the proportion of one-third of their nominal share capital, and to supply gas of 16-candle power tested at the works, or 15½-candle power as tested in the district. After a discussion upon the charges made for public lighting, the Committee passed the preamble; and on Thursday the clauses were settled, and the Bill, as amended, was ordered to be reported to the House. The Bill of the British Gaslight Company, relating to the finances of their Norwich undertaking, was also advanced a stage, practically as it was submitted, with the same increase in the proportion of borrowed capital as in the Newcastle and Gateshead case. The Company further agreed to raise their new loans in the manner that may be most advantageous at the time. The illuminating power of the gas was agreed to be raised from 14 to the now standard 15 candles. An audit clause similar to that inserted in the Company's Potteries Bill of last session was also accepted. The Cowes Gas Company's Bill passed another House of Lords Committee. Interesting evidence bearing upon the history of competition in gas supply was given by Mr. George Livesey and Mr. Corbet Woodall in connection with the opposition of the Metropolitan Electric Supply Company to the proposed grant of competing powers of supply in the Strand District to the Charing Cross and Strand Electricity Supply Corporation. The opposition was not successful.

The Chesterfield Award.

The arbitration to determine the sum to be paid by the Chesterfield Gas and Water Board for the undertakings of the Chesterfield Water and Gas Company, in accordance with the terms of the Act of Parliament constituting the Board and authorizing the transfer, has eventuated in the award by the Umpire (Sir George B. Bruce) of £106,500 as the value of the gas-works, and £125,336 as the price of the water undertaking. In addition, the Company's mortgage debt, amounting to £13,500, has to be taken over by the Board; thus making the total sum to be paid for the property £245,336. It will be instructive to give a short history of the arbitration. At the very outset a question arose as to whether the purchase should be regarded as by compulsion or with consent. The Company, for reasons set forth by their leading Counsel (Mr. C. A. Cripps, Q.C.), took the former view; and their witnesses, by a display of ingenuity which can only be properly characterized as marvellous, sought to justify a claim of £205,000 for the water, and £221,418 for the gas—together, £426,418. The Board had had a valuation of the two properties made by Mr. W. B. Bryan and Mr. Corbet Woodall, and upon their advice had offered the Company £211,500 for the water and gas portions, which with the mortgage debt made a total of £225,000. The result has amply justified the steps taken to arrive at a settlement. We cannot affect to condole with the Company upon the outcome of the arbitration. According to Mr. Lass, the water-works have actually cost £89,852; and the gas-works stand in £92,446. The share capital is £173,000; so that the proprietors will presently get a return of £13 for every £10 share—not at all poor compensation for having to relinquish their property, especially if the half of what was given in evidence as to the condition of the works is true. On the other hand, the new Board will enter upon the possession of a sound undertaking, admittedly susceptible of great development, under conditions as to capital burden which cannot be characterized as too heavy in the circumstances. The record of the arbitration proceedings as we have published it in a series of numbers of the "Journal" commencing with that for the 11th ult. is a valuable study of its kind. The Company were not well advised in asking so much as they did for their property, which was the primary reason why the opposition said such unpleasant things about it. Now that the business is over, it may be hoped that the Board will set about putting both undertakings in order; and if the local public will only rally to their support, it may not be long before Chesterfield will congratulate itself upon having made what, upon Mr. Littler's showing, was more of the nature of a compulsory purchase than it could be said on behalf of the Company to be a compulsory sale. The distinction is a curious one; but it appears to cover a very real difference. There is little more to be said respecting this award, except perhaps to utter a warning against placing too much reliance upon any calculation of the number of years' purchase of dividends or profits which may be based upon the Chesterfield figures, as indicating what is the approximate value of any apparently similar properties. As a matter of fact, Chesterfield stands for itself; and there is hardly a point in the valuation proceedings that can be rightfully regarded as a precedent. The best general lesson that can be drawn from this arbitration is the old one, that those who open their mouths too wide are not the most likely to have them filled.

The Incandescent Lamp Litigation.

The hearing of the incandescent gas-burner lawsuits was continued last week; the first case not being finished until yesterday. Judgment was deferred; and it is uncertain at present when it will be given. After the De Mare case was closed, that of the Sunlight Company was opened. Our notice of the action last week placed before readers the issues raised in the De Mare action, and referred almost exclusively to the presentment of their case by the plaintiffs, the Incandescent Gas-Light Company, Limited. Our report of the proceedings in Court finished with Friday's business; and this week we give the continuation, which contains the defendants' case. Mr. Bousfield, Q.C., concluded on Monday, the 16th inst., his most masterly opening speech for the defence and called his witnesses, among whom were Dr. Otto Hehner, Sir Henry Roscoe, Dr. Dupré, Professor V. B. Lewes, and Mr. Sheldrake. The evidence of these experts was necessarily of a somewhat heavy nature, dealing as it did with recondite considerations concerning the chemistry of the "rare earths." The proceedings were, however, on several occasions lightened, in more than one sense of the word, by experiments illustrative of the points of disagreement of the different "doctors" as to the sufficiency of Herr Welsbach's first prescription for the manufacture of his "mantles." As the proceedings wore on, it became evident that the principal interest was concentrated upon these points; the Judge intimating that he had formed his opinion respecting the allegations of anticipation. Those who are interested in the cause of improved gas lighting should not omit reading a line of our condensed, but comprehensive, report of this remarkable lawsuit.

A Pitiful Example.

One of the few remaining representatives of the New Unionism in Parliament is Mr. J. "Havelock" Wilson, whose success in retaining his seat, when so many of his kind were ignominiously toppled back into the oblivion from which they never arose for any good purpose, was one of the surprises of the last General Election. Mr. Wilson's character as a "Labour leader" has been grievously besmirched by a great many hands; but the most outrageously libellous attack upon a public man to be found in the varied literature of British political warfare was contained in a pamphlet which certain of Mr. Wilson's enemies printed and published with the avowed intention of doing him dishonour. In this choice publication it was asserted that the subject of it has no recognizable right to the name, or rather to the more distinguished of the conjoined patronymics, by which he permits himself to be known. This is perhaps a small matter; for the step from an insignificant surname to a tentative compound, and thence to a regular double-barrelled cognomen, hyphen and all, is not infrequently taken by politicians and others justly distrustful of their ability to throw distinction upon the name to which they were born. The pamphlet in question, however, asserted without any circumlocution

that Mr. Wilson had taken other things, besides a name, to which he was not justly entitled. It was pleasantly suggested, in short, that he was simply a disgrace to the House of Commons. The remedy of any individual who may be assailed in this way is perfectly clear. Public opinion requires that he should instantly avail himself of his legal remedy; and although the practice of the "duello" is no longer in vogue in this enlightened country, if a man conscious of his honour goes beyond the bounds of strict legality, and inflicts personal chastisement upon a malicious detractor, he is not thought any the worse of for his turbulent behaviour. In the case of Mr. Wilson, discretion proved to be altogether too much the better part of valour. He instituted his action for libel; but when his case came on, he flatly declined to go into the witness-box in his own justification, and submitted to the contemptuous verdict giving wounded honour a solatium valued in the smallest coin of the realm, with deprivation of costs. After which, to make matters worse, he went whining to the House of Commons with a request that a "Committee of Honour" might be constituted to investigate his position. One cannot help thinking that the word "honour"—one of the greatest in all languages—comes badly from the mouth of Mr. Wilson.

One has no desire to dwell upon the very unpleasant spectacle presented by this person; but it is necessary to draw attention to his case for the sake of the lesson it conveys when rightly considered. There have been a good many "new" movements and causes started of recent years, by people who have assumed, as the preliminary credential of their selection for the business, a right to dispense with the legal and moral obligations which are recognized by the majority of us. The New Unionism, among other temporary crazes, was created by a set of demagogues who never pretended to speak the truth, and had small compunctions on the score of picking and stealing, whether from the capitalist or their confiding dupes among working men. Nor did they shrink from fomenting violence and outrage of the cruellest character when they had ends to gain thereby; although they usually preferred, as a matter of expediency, to "lead their regiments from behind," like the bold Duke of Plaza Toro. Now all these aberrations are working themselves out to their natural end. Some of the clumsiest and most transparent of the "new" demagoguery are in gaol, or have otherwise "gone under;" a few of them have shown a disposition to "forswear sack and live cleanly;" and the rest must be cleared away sooner or later—the sooner the better. Anyhow, it is of the first importance that all persons of this order, and the public who have applauded and supported them, should understand that the eternal laws of fair dealing and right speaking are not to be set aside by agitators for their own ends, and that for those who attempt any such desperate enterprise there is a "hereafter" to be reckoned with which does not always wait for their previous exit from this transitory life. It is all very well to repeat with the Pompadour, "After me the deluge!" But who can really assure himself that the inevitable ruin will be obliging enough to wait until after he has passed beyond its reach?

Cottonwood Water Power and Electric Company, Limited.—The letters of allotment for the preference and ordinary shares in this Company, noticed last week, have been posted.

The East London Water Company's Dividend.—The Directors of the East London Water Company recommend a dividend of 3½ per cent. on the ordinary stock for the half year ending Christmas last (less income-tax); carrying forward £8444.

Holyhead and North Wales Gas and Water Corporation, Limited.—The first batch of letters of allotment and regret have been posted to the applicants for shares in the above-named Corporation, the prospectus of which appeared in the "JOURNAL" last week.

Received.—"Der Gas, und Wasser-Installateur." Nos. 1—3. (Strasburg: Tormin and Lipp.)——"Eleventh Annual Report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts." (Boston: Wright and Potter Printing Company.)

Coal in Kent.—With reference to a proposal which has been brought forward to start a colliery to the west of Dover, the land has been inspected with a view to ascertaining the most desirable site upon which to sink the shafts. It appears that for some time past a Syndicate has been buying up land in the neighbourhood wherever available, and acquiring extensive mining rights; the total area thus secured now exceeding 5000 acres.

WATER AND SANITARY AFFAIRS.

As we mentioned last week, the Government measure relative to the Water Supply of London and surrounding districts was introduced in the House of Lords, prefaced by a statement by Lord James of Hereford in explanation of its provisions, which will be found elsewhere. The first effect was to induce the London County Council, on the following day, to decide unanimously that the report of their Water Committee, recommending the adoption of the scheme for a supply to be obtained from Wales, should stand over until after the Easter recess. Lord Onslow, who proposed this adjournment, in consequence of the appearance of the Government Bill, was less fortunate in the Parliamentary Committee of the Council on Thursday, when he proposed a like postponement of the consideration of the Transfer Bills. The Progressives out-voted him by a majority of one, and resolved, as "The Times" states, to "brook no further delay." We can only say that if they intend to push their Bills, there is a tolerable certainty they will succeed to the extent of pushing them over a precipice. The Transfer Bills which await second reading are among the orders for to-day in the House of Commons. If the members having charge of these measures insist on the motion for their second reading being at once put to the House, it will be little better than compelling the Government to give an adverse vote. The Progressives may prefer to have the Bills thus sacrificed, seeing that everything relative to the London Water Supply will pass out of the hands of the Council if the Government carry their measure for the establishment of a Water Board. But, as we have signified before, the Council are not wanted in this matter. Supposing the Government measure to be carried as it stands, the Water Board will be constituted "before the expiration of one "month after the passing of the Act," and will forthwith assume all the powers which the County Council now exercise in reference to the water supply. On that particular question, therefore, the London County Council will be dead—killed, in point of fact, by Act of Parliament—as soon as the Metropolitan Counties Water Board comes into existence.

That the Transfer Bills will not get through Parliament is reasonably certain. The London Unionist members have told Mr. Chaplin and Lord James that they will oppose the second reading. That the Government Bill may fail is just possible. If there is to be a breakdown on both sides, the Companies remain in existence; and the only change will be some extension of works, so as to keep up a proper supply of water throughout the districts. In this matter the Companies stand very well; Mr. Chaplin having intimated that he will to-day move for the appointment of a Hybrid Committee to whom all the Bills promoted in the present session by the London Water Companies shall be referred, including the Bills of the Chelsea and Lambeth Companies suspended from the past session. Mr. Chaplin intends, as already signified, to move an Instruction to the Committee that no works are to be authorized except such as cannot be deferred without detriment to the interests of the public. The error which led to the East London disaster is not to be repeated. But the Committee will have a difficult task before them in deciding how far they ought to go. The Bill for the Staines reservoirs, which is looked upon as a large affair, is simply an instalment of the entire project, and provides for a term of years which must inevitably elapse before a supply can be brought from Wales, or from any other distant source. The New River Bill, and the Bill of the Southwark and Vauxhall Company, are affected, more or less, by the same consideration. In short, any material change in the sources of the Metropolitan Water Supply is a remote event; and, in the meantime, the whole of "Water London," with its 620 square miles, will be dependent on the Companies. The public have been told that the present sources of the supply are failing, or even "exhausted." Yet the Government act as if it were necessary to prevent the Companies from drawing as freely as they would from these "exhausted" sources. That the Companies would not propose to construct reservoirs unless they expected to fill them, may be fairly inferred. Amid the bevy of London Water Bills now before Parliament, it is interesting to

note that the County Council have a report before them to-day recommending that the Height of Supply Bill "be "not further proceeded with."

The Government have offered a sop to the London County Council in proposing that they shall have the power to nominate as many as sixteen out of the thirty members of the Water Board. It may be further gratifying to the Council that the Corporation of the City are only to have two representatives. Figures have been cited in support of this arrangement; but there is a manifest absurdity on the face of it. Figures are also given to show that West Ham should have as many representatives as the City. Statistics do not settle everything; and though the comparison in this case is not quite that of Lombard Street to a China orange, yet there is evident want of due proportion. In the same category we find the County Councils of Middlesex and Essex. The County Councils of Surrey, Kent, and Hertfordshire, together with Croydon, are each to have one representative, as also the Conservancy Boards of the Thames and the Lea. It is provided that the parties elected need not be members of the body electing them. The Water Board thus constituted is to treat with the Water Companies with a view to obtain possession of the several undertakings. But the Board are not to have power to decide anything finally. Whatever they want must be made the occasion of a request to Parliament in the shape of a Private Bill. Thus the water question is to be kept in the hands of the Legislature, where it may properly rest. But the Progressives are dead against the scheme, and will leave no stone unturned to ensure its defeat. Should the Bill be rejected, the event will not hurt the Government, though they would naturally like to have the credit of dealing successfully with the question by which they were upset in 1880.

A marked feature in the Bill, especially as explained by Lord James, consists in the distinct departure from the narrow limits of the Administrative County of London. The Government have looked ahead. They perceive the rapid growth of the population living outside the present boundary, and they recognize the necessity of providing for the altered and enlarged conditions of the future. They also dissent from the idea of cutting off the outer areas, and, as Lord James expressed it, "dissecting" the water supply. This comprehensive plan fails to commend itself to the Progressives, who know very well that the London County Council would never be allowed to rule as a Water Authority over so extensive an area. But it would certainly be a disaster if the water supply were severed so as to place Inner London by itself; leaving the outer districts to struggle among themselves with inadequate means for a supply to meet their rapidly increasing wants. The force of circumstances has led the London Companies to carry their mains far and wide, under statutory powers obtained for the purpose, and the same force is at work still, with even greater energy. Another feature of the Government measure is that it aims at the purchase of the undertakings of the Water Companies, though in the meantime establishing control. This is at least better and more just than the County Council's plan of taking possession on an "appointed day," and settling the terms of purchase at their leisure. Perhaps it should be explained that, in our comments on the Government Bill, we have been guided by the explanations offered by Lord James. We confess that in one or two points the Bill is not quite so explicit as the Ministerial statement. No doubt amendments will be introduced, and we may expect to see the Bill somewhat enlarged.

Subways in the City of London.—In his report on the works executed by the Commissioners of Sewers of the City of London during the past year, the Engineer (Mr. D. J. Ross, M.Inst.C.E.) gives some information with regard to the subways for gas, water, and other pipes, and the extent to which they are used. Beneath the City streets there exist at the present time about 2360 yards, or nearly 1½ miles of subways, wherein are laid 2 miles 264 yards of gas-mains, 1 mile 1221 yards of water-mains, 732 yards of hydraulic supply mains, 1 mile 1408 yards of telegraph and other tubes, and 1 mile 600 yards of electric lighting conduits—making a total of 7 miles 705 yards. Mr. Ross states that no openings for access to pipes, &c., have been made in the streets beneath which there are subways since the latter were constructed. The Inspector in charge reports that 7016 persons were admitted for various purposes during the past year.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 656.)

THE markets in general on the Stock Exchange have been very quiet during the past week. The fact is that, without becoming exactly apprehensive, people are in a serious mood for reflection, and are considering whether John Bull's commitments are not becoming just a trifle heavy: South Africa, Armenia, Venezuela, Ashanti, and now Egypt and the Upper Nile—truly a formidable array. The consequence is that a policy of masterly inactivity is rather in favour; and business in everything—from Consols down to the "heads-or-tails" sort of stuff—has been decidedly limited. Thus prices, with a few rare exceptions, show a marked falling off. With the settlement this week and Easter to follow, there does not appear much probability of any alteration yet awhile. The Money Market presents no new feature. Business in the Gas Market was most characterized by the hostility to Gaslight "A." We ventured last week to prophecy a fall; and it has had a big one—business being done at 302 on Monday, and getting worse every day until 290 was marked on Saturday. However, while the ordinary stock was suffering, the secured issues of all sorts—debenture, preference, and limited—were in great favour; and all had a more or less substantial rise in quotation. South Metropolitans were not quite so active as in the preceding week; but they were very strong. Top prices were repeatedly realized by the "B" and "C;" while the "A" had a further advance. Only one bargain was marked in Commercials; and it put the quotation up a couple of points. Very little business was done in the Suburbans and Provincials for lack of stock; and the only move was a slight advance in Alliance and Dublin. It may be noted, however, that a fair number of shares in several of these undertakings were sold at the Mart on Wednesday, and realized record prices. Among the Continentals, Imperial was a good deal offered; and the quotation fell apoint. But prices at the close were a shade better. European and Union were firm. None of the other Companies presented any particular feature. Business in Water was a good bit quieter; and prices, though for the most part rather better, were not uniformly higher. East London and Southwark were a little lower. The Companies are believed to be not particularly enamoured of the Government scheme as far as it goes; and it leaves a great deal of room for improvement.

The daily operations were: Business in Gas on Monday was nearly all in Gaslights; and the "A" fell 1¼. The 4 per cent. debenture, however, rose 1¼. Pará fell ¼. On Tuesday, Gaslight "A" and Imperial engrossed attention; and the former receded 2. In Water, East London, Lambeth, and New River debenture rose 1; Lambeth 7½ per cents., 2; and Grand Junction, 2½. Wednesday was very active, and Gaslight "A" was put down 2 more; but the "H" rose 3. Thursday was equally animated; Gaslight "A" and Imperial Continental being again freely dealt in. The former fell 3; the latter, 1. Commercial old and South Metropolitan "A" advanced 2. Friday was not quite so active. Gaslight "A" fell 3; but ditto "F" and "G" gained 5 each; and "J," 2. Alliance rose ½. In Water, Kent new moved up 2; and Grand Junction debenture, 2½; but East London and Southwark fell 2. Saturday was quiet and unchanged.

ELECTRIC LIGHTING MEMORANDA.

Mr. Addenbrooke upon Direct versus Alternating Supply Systems—The Advent of Increased Voltage—A Choice of Eventualities—The Cost of Using Incandescent Lamps—The Need for Caution.

THE electric lighting interest is deeply concerned in pushing the new high-voltage incandescent lamp; and good service was done in this regard by the Institution of Electrical Engineers on Feb. 27, when a paper on the subject, by Mr. G. L. Addenbrooke, was read and discussed at a meeting of the Society. The text of the paper appears in the current number of the "Electrician," which also comments upon, but does not report, the discussion. The influence of the new kind of lamps upon central lighting undertakings is likely to be potent in several ways. Mr. Addenbrooke investigates the subject in a searching manner, beginning with an examination of it as bearing upon the question of the comparative advantages of direct and alternating supply systems. As from 1891, when the controversy between the partisans of these systems last came formally before the Institution of Electrical Engineers, it has been understood that the advantages of the systems were in many cases pretty evenly balanced. Mr. Addenbrooke sums up the position by saying that if one or the other was ultimately to prevail, it would probably be for some other reason than anything recognized at this period. We may remark that it had become a commonplace to hold that for closely-packed districts lying conveniently round the central station, the direct-supply system was considered to be more suitable; while for scattered districts, the alternating

system was held to be more economical to establish. As Mr. Addenbrooke well observes, however, this opinion left untouched the difficulty of drawing a line; and it also left open the serious question of whether two systems should be permitted in the same town.

At this period, a direct-supply system meant also supply at low pressure; and feeling the necessity of settling his own mind upon the whole matter, Mr. Addenbrooke "made a careful survey of the field," and satisfied himself that there were certain eventualities which were capable of profoundly affecting the issue. These were: (1) The introduction of an altogether new form of lamp; (2) a cheaper material for mains than copper; (3) a high voltage incandescent lamp; (4) a much more economical incandescent lamp of the present voltage; (5) an improved and much cheaper storage battery. All these, be it observed, are radical matters; but they do not all apply to one system of electrical supply more than to the other. A year or so ago a definite step was taken on the initiative of Mr. Baynes, then of Bradford, in the direction of the realization of one of Mr. Addenbrooke's eventualities. This was the introduction of direct-supply current at a pressure of 200 volts, attended by lamps to suit. The innovation was so successful, from the electricians' point of view, that at the present time lamps marked for 230 volts, and even higher, are offered in the market.

Concurrently with this development, there has arisen a tendency to try another of Mr. Addenbrooke's eventualities—the employment of lamps of higher efficiency at the ordinary voltage. Thus the consulting electrical engineer has been confronted with the interesting dilemma of whether he should favour the use of 100-volt lamps, taking (say) $2\frac{1}{2}$ watts per candle power, or lamps taking 4 watts per candle power, as is usual, with a voltage of 200 or 220. Incidentally let us remark that the former alternative would appear to favour the consumer, while the latter more directly benefits the supplier of electricity. Curiously enough, this aspect of the problem is not directly noticed by Mr. Addenbrooke, who proceeds to discuss the alternatives as if they were of equal and similar bearing. He arrives at the conclusion that the latter is to be preferred. He does not believe that a good and reliable $2\frac{1}{2}$-watt lamp of 100 volts is attainable under existing conditions of manufacture and use. On the other hand, it is declared that a good 16-candle lamp, to take from $3\frac{1}{2}$ to 4 volts per candle power at 220 volts, is to be had; and this so far settles the question.

At this point, Mr. Addenbrooke begins to think of how the matter is likely to strike the consumer. He admits that the life of these high-voltage lamps cannot be expected to be as long as that of lamps of half the voltage, while at the same time they will be rather more expensive. Consequently, there must be a greater expenditure for lamp renewals when such lamps are used; and he endeavours to ascertain what this may mean in actual figures. In so doing, he makes some calculations which may be of interest to our readers, who frequently apply to us for just this kind of information respecting the working of incandescent electric lamps:—

> If the life of an ordinary 16-candle power lamp of 100 volts is 1200 hours, and it consumes 64 watts (per hour), during its life it will consume 77 Board of Trade units, which, at 6d. per unit, amounts to 38s. 6d. If the cost of the lamp is 1s. 3d., its cost per unit of current consumed is 0·2d., or $\frac{1}{5}$d., or about 3 per cent. of the cost of the current. For an 8-candle lamp of 100 volts, lasting 800 volts and taking 36 watts, the consumption of current is 29 units; and at the same price for lamps, the lamp cost per unit of current consumed is about 0·5d., or $\frac{1}{2}$d., or about 8 per cent. of the cost of the current. I have assumed the above life for these lamps because I think, after burning the number of hours indicated above, most lamps would be best thrown away; though I am perfectly aware lamps often last twice as long as I have assumed, and they can also be purchased for 20 per cent. less from reliable makers. 200 or 220 volt lamps will, of course, cost rather more; and their life would be rather less. But I am putting the case more adversely for the higher-voltage lamps than is really true, in taking the cost as double the above rates for lamp-renewals where high-voltage lamps are used. The cost of lamp renewals would then be 6 per cent. of a customer's bill if the current was 6d. per unit, for 16-candle power lamps; and 16 per cent. if 8-candle power lamps were used. Supposing the number of 16-candle power lamps installed to 8-candle lamps is about as 1:2 (which is, I think, about a fair average), an all-round reduction of 6 per cent. in the charge per unit of current would cover the *additional* cost of lamps, if lamps of high voltage were used. At 6d. per unit for current, this is about one-third of a penny per Board of Trade unit.

Then Mr. Addenbrooke explains the advantages of direct supply, at 220 volts, from the central station standpoint; maintaining that it means increasing the area that can be served from such a station about eleven times the present surface. At this rate, the number of electric lighting stations that would comfortably serve all London would not exceed six or seven, which is directly comparable to the number of the Metropolitan gas manufacturing stations. It will be gathered, from what has already been given of it, that this paper is of high value. Nothing detrimental to the author's position appears to have come out in the discussion, except the declaration of several electricians to the effect that a good 8-candle power 200-volt lamp cannot at present be made, for lack of which they will have nothing to do with the new system. Our electrical contemporary is inclined to advise central station engineers to "go slow" in the matter of adopting the new standard of voltage. These ardent gentlemen are recommended to look at the proposed change from the consumer's point of view; because if they do anything to offend his susceptibilities, it will be a bad thing for the electric lighting industry. "We cannot afford to increase either the trouble or the general expense of electric lighting, if it is ever to become the universal illuminant." This is sound counsel. Meanwhile, an outsider may be permitted to question the validity of any proposed "improved" system of lighting which limits the freedom of the consumer in selecting the size of his lights.

INDUSTRIAL ECONOMY ILLUSTRATED.

It must be admitted that there is, to the ordinary man, something very forbidding about studies in political economy. This is quite natural, inasmuch as the science of political economy is all theorizing; and there is nothing of which the ordinary man is more impatient than what he is prone to speak of disrespectfully as "mere theory," at the same time that he professes the highest regard for facts. A fact is commonly spoken of as a "stubborn thing," which will fall upon a man and crush him if he attempts to undermine it, and against which he may knock his head in vain. It is difficult for people who talk like this of facts, to understand that there is another way of treating these solid realities—namely, to observe, measure, and classify them—still more to perceive that this is the most helpful way of dealing with them. Now, political economy is the mass of deductions that more or less competent observers have drawn from the accumulated experiences of men in regard to their mutual relations of many kinds; and it ought to constitute a favourite study of those who call themselves "men of the world." It is partly because this is not so that individuals and masses of men of the "practical" order so constantly act foolishly in respect of those very matters which they might be supposed to best understand.

It is not our intention to recommend readers to commit themselves to definite courses of economic study; for text-books of economics, like those of chemistry and other sciences, are apt to be only too stiff for reading by men of affairs. We do, however, advise that a keen look-out should be kept for new books dealing with special aspects and departments of political economy which may prove helpful to business men and those charged with the management of industrial establishments. If it is worth while, say, for gas managers to provide themselves with manuals of engineering chemistry, and the like, it is equally worth their while to acquaint themselves with the writings of such leaders of the younger school of economists as Professor Nicholson, of Edinburgh. A copy of a collection of essays by this admirable teacher lies before us. It is entitled "Strikes and Social Problems;" and it deals largely with industrial troubles and their curative treatment. Men occupied with the management of other men never know when a portentous industrial "fact," of the character we have been describing, will arise and menace their peace and the interests committed to their charge; and there is comfort and help in the habit, acquired as the reward of previous study, of regarding these things in the light of general principles. Men who are too exclusively "practical" are liable to be more upset by the unexpected rising of awkward facts under their hand, than those who are able to refer everything of the kind to its proper category, as part of a very general experience.

Professor Nicholson has, at different times during the last five years, written upon current topics of interest in respect to industrial issues; and these collected writings are profitable to read (now that the particular issues are composed), as showing how pertinent, or otherwise, the words of the professed economist may be when criticizing "burning questions" of a day. The first essay in the present volume treats of the Federated Coal Miners' strike of 1893; and the most prominent feature of it is the author's insistance upon the importance, in all such affairs, of a clear ascertainment and setting-forth of the facts. In connection with this particular strike, it was almost impossible to get at the facts—whether of the men's actual earnings, or of the nature of the proposals they were fighting over, or the employers' financial position. Professor Nicholson's conclusion upon this is that the first remedy for strikes is not to be sought in more legislation, but in "more light." This suggestion bears out what we have observed respecting the Government Bill to make better provision for the settlement of trade disputes. "It is quite true," says the author, "that a Board of Conciliation or of Arbitration cannot enforce its recommendations; but it can throw light upon the subject in dispute, and point out what is for the interest of both parties. And there can be no doubt that the pressure of public opinion would be brought to bear on the side of justice. The great difficulty now, in bringing public opinion to bear, is that the facts are not known." The recent engineers' strike in Belfast and Glasgow is another case in point.

Upon the vexed question of the "living wage," Professor Nicholson is cogent and strong. He denies, to begin with, that the general rise in the rate of wages in this country during the last fifty years is either obviously or certainly an effect due to the contemporaneous advance in the organization, numbers, and wealth of Trade Unions. The most numerous industrial occupations have never come under the operation of Trade Unions; and yet in these the rise of wages has been most

marked. "When we look beneath the surface, we soon discover that the power of Unions to raise wages is extremely limited. All the Unions can do is to take advantage of favourable conditions; they cannot create these conditions . . . they have neither invented machinery, nor opened new markets, nor extended credit." This is precisely the same lesson we gave on Feb. 18, in the article entitled "The Secret of Industrial Prosperity," which was written before Professor Nicholson's book came to hand.

Well, then, what is to be said about the latest figment of Trade Union imagination—the "living wage," and the possibility of maintaining it by the power of strikes? It is agreed that a fair day's wage for a fair day's work is a most reasonable and attractive ideal. It is even possible to go further, and say that "the higher the wage and the less the work—provided always that other classes are not injured—so much the better." But to suppose that any class of labourers can obtain a fair reasonable wage simply by refusing to work below that rate, is a gross and mischievous fallacy. Unhappily, it is not so easy to expose the fallacy so as to be clearly comprehended of those who are interested in maintaining it.

Professor Nicholson proceeds to argue that if a living wage is to mean anything, it must refer to the earnings over a considerable period—say, a year. That is, there is no connection whatever between the nominal rate of wages and the actual income of the worker. "In other words, a living wage without regular employment is a delusion. Now, it may be all very well to strike for higher wages; but whoever heard of a strike for more regular employment?" If men absolutely refuse to work for less than a certain rate, several things must happen. Some employers with the least productive establishments must cease working altogether; thus throwing a number of men out of employment. If the labourers in and out of employ agree to share and share alike, the average share will obviously fall below the living wage. If they are not so communistic, some of them will go without wages altogether.

Within the last few days, the country has been treated to an object-lesson which bears out this reasoning in every particular, and is, moreover, so obviously matter-of-fact that the most "practical" of men must be able to grasp its significance. The Government are about to spend a lot of money for shipbuilding; and a deputation representing the East-end of London waited last Tuesday upon the First Lord, to ask that some of the contracts should be given to Thames yards. The deputation, said one of the spokesmen, "came to express the heartfelt desire of at least a million people who suffered from the great depression and threatened extinction of the shipbuilding trade of the Thames." There is no disputing the fact; but, as Mr. Goschen pointed out in his reply, the Trade Unions have succeeded in forcing the London standard of wages for the different trades employed in shipbuilding and repairing to 15 per cent. above those of other ports. It is a bad thing for the men that they cannot get their standard wages; but what, as Mr. Goschen asked, is the good of setting up a standard if no work can be had at the figure? He ventured to think it would be better for the men to have ships to build than to remain idle with these rates of wages on their books. It would be impossible to ask Parliament to support the Thames yards, for the sake of maintaining an unnaturally high standard of wages, which would only be done at the expense of the taxpayers. Besides, why subsidize the Thames yards only in this way? The mere suggestion opens up a vista of political and economical jobbery which could not be countenanced by any honest statesman.

One cannot help thinking how a concrete example such as this points the moral of the economist's teachings. But let us give the teacher the credit for defining the basis upon which the practical administrator can safely rest his policy. Professor Nicholson confesses that, in his opinion, our Trade Unions have reached a point in their development at which they are threatened with serious dangers. He remarks that these organizations have often been compared to the old Craft Guilds; and he admits that the comparison is instructive in more ways than one. "At the very time when England was beginning to acquire the commercial supremacy of the world, when the discovery of America, the Reformation, the breakdown of feudalism, and other social forces were causing a vast increase in material prosperity, on all sides there were complaints of the decay of the towns. And what was the reason? The principal reason was that the Guilds, by their selfish restrictions and their monopoly prices, had driven industry to places where it could grow in freedom. Let the Unions be warned in time—the attempt to keep up wages at the expense of the consumer, or to force capital to work without profit, is a suicidal policy. If we once lose our markets, no amount of strikes will restore them; and if freedom of enterprise is once lost, our markets are lost also, and the living wage will dwindle down to starvation point." The experience of the Thames shipbuilding trade proves that this is no vain prediction. And who suffers thereby? Of course, the capitalist, in so far as his expenditure on fixed plant is concerned. But the rates of the district are also gone up to 8s. 10d. in the pound, which shows that the evil is pretty generally distributed.

Professor Nicholson's book also includes an essay on profit-sharing—which, by the way, is dated 1890, when the South Metropolitan experiment, to which he alludes, was only just started. He ought to write another, in the light of later knowledge. Incidentally, however, he disposes of the plausible objection that where there is profit-sharing there should also be loss-sharing. "There is only one possible answer to this objection, which is the answer that was given by M. Leclaire, and which is the kernel of the whole matter. *Under the stimulus of profit-sharing, the workers must create the additional profits which they are to receive.*" [The italics are in the text.] If the system works at all well, this is how it must work; and by the same means it is plainly possible for wages and profits to rise together. To the Socialistic objection which is taken to this very feature—on the supposition that no benefit can accrue to the worker that is not so much loss to the employer—Professor Nicholson pays no attention. He is careful to show, however, that the recommendation of the principle of profit-sharing is not that of charity or philanthropy, but essentially of economics. It is as a purely business method that he treats it—believing that the more successful the system is as a matter of business, so much the more will it tend to bring about those moral and social results for which in most quarters it is generally recommended. "The constant effort to make the most of the concern, the creation of a keen *esprit de corps* among the workers, the knowledge that to a large extent the interests of masters and men are identical, the application of a share of the profits to social purposes, the opportunity for the gradual accumulation of capital out of extra earnings, and the consequent sense of independence—all these are factors which make for the moral elevation both of masters and men, and tend to diminish the friction between classes." After these words of wisdom, we commend Professor Nicholson to our readers' further study.

PERSONAL.

Mr. W. M. Richardson, of Derby, has been elected Chairman of the Duffield, Allestree, and Quorndon Gas Company.

Mr. J. T. French and Mr. E. Stocker have joined the Board of the Sheppy Gas Company; the former in place of Mr. S. G. Elliott, deceased, and the latter in succession to Mr. J. Poole, who has resigned on account of ill-health.

Mr. Truscott, the Chairman of the Lighting Committee of the Maidenhead Corporation, and a shareholder in the Gas Company, has resigned his position, in consequence of the Town Council having been advised that gas shareholders are debarred from taking any part in lighting questions.

Mr. George E. Saville, who has for many years managed the Todmorden Gas-Works, has decided to resign, having received an appointment as Engineer and General Manager of the Holyhead and North Wales Gas and Water Corporation, Limited. He was Manager of the Todmorden Gas Company previous to the works being purchased by the District Council, and has served in the same capacity since their transfer.

OBITUARY.

Mr. George Parker, Manager of the works of the Oakengates and St. George's Gas and Water Company, Limited, died on the 11th inst., after a short illness, in his 72nd year. He had held his position for 26 years.

Mr. Jabez Church, M.Inst.C.E., F.G.S., died on Friday last. Deceased was the son of the late Mr. Jabez Church, for some years Engineer of the Chelmsford Gas-Works, who was President of the British Association of Gas Managers in 1892. He was well known as a gas and water engineer; and was connected with several undertakings, for some of which he designed the works. He was a Director of the Hornsey Gas Company; and was President of the Society of Engineers in 1883.

Mr. J. Wilcock, the Manager of the Shipley Gas Company, died at Morecambe last Tuesday. Mr. Wilcock entered the service of the Company 37 years ago as junior clerk; and he quickly won his way to the responsible position of Manager and Secretary. In 1871, when he took over the management of the business, the annual consumption of gas was 43 million cubic feet; and it has mounted up, until last year it was 147 millions. The great success of the concern may to a large extent be attributed to the energy and perseverance of Mr. Wilcock, who was highly esteemed by the Directors. Deceased, who had been in failing health for about two years before his death, was 53 years of age; and had held his position for 25 years.

Altering the Shape of Electric Incandescent Lights.—A suggestion for the conversion of the line of light given by the filament of incandescent electric lamps into an apparent plane surface of light was recently communicated to the Physical Society by Sir David Salomons. It consisted in subjecting the lamp being rendered incandescent by an alternating current, to the influence of a large electro-magnet brought into its vicinity while excited by a continuous current. The effect of this is to set the filament in vibration, which, if the magnet is brought sufficiently near to it, is so violent as to break it. It was stated that the number and position of the nodes formed in the vibrating filament were independent of the natural period of oscillation of the filament, such as would be shown by ordinary mechanical shaking, but depended on the frequency of the alternating current.

NOTES.

A Novelty in Gas-Taps.

A self-locking gas-tap has just been invented and patented by Major T. A. Skelton, of Southampton; and it is shown in the accompanying illustrations. Its purpose is to ensure the safe turning off of the tap, and to prevent its accidental turning on again—the too frequent cause of escape of gas, and consequent accident. Fig. 1 shows the tap fitted with the lock—the upper figure representing the tap turned off, or locked; and the lower one the tap turned on, or free of the lock. A is a flat disc, perforated so as to slide vertically on the pins B B, and having a slot in the under side to receive and lock the handle when

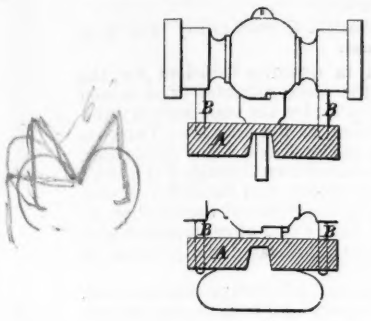


FIG. 1.

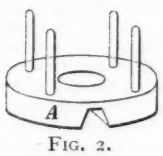


FIG. 2.

the tap is turned off. When turning on, the disc is simply pushed up by the finger and thumb as the handle is turned; and it is then kept up free by the handle itself. When intended for use with old taps, the pins B B are omitted, and four arms are substituted, fixed to the upper side of the disc below the arms embracing the body of the tap. These are shown in fig. 2. The object of both pins and arms is to prevent the disc from turning horizontally. The invention is of special interest to suppliers of gas, as tending to add to the safety of their commodity as a household illuminant. Gas is already the safest as well as the cheapest domestic light; and a tap like the one under notice, which will really protect consumers and the public against their own carelessness, will, we should think, be cordially received, especially as, being automatic, it does not give any extra trouble, and is also simple and inexpensive, while the lock can be added to taps already in use.

Joints for Petroleum Pipes.

Mr. Hiram S. Maxim has published some useful hints as to the way in which pipe-joints can be made tight for petroleum of all grades, including the lighter fractions of naphtha and gasoline, when subjected to heat and pressure. The main condition of success is to employ some caulking material which is insoluble in petroleum. In Mr. Maxim's experience, he finds a pipe which is merely screwed together dry less apt to leak petroleum than one made up with the usual red lead and oil. To make an effective petroleum joint with screwed pipes, a good plan is to warm both ends sufficiently to dissipate every trace of oil, and then make the joint up with thick shellac varnish with which ordinary dry vermilion or even Venetian red may be combined. A very good joint for petroleum can also be made with ordinary yellow soap rubbed into the threads, after the grease has been removed as before. Treacle, glue, mucilage, or glycerine are petroleum-proof. For packing a stuffing-box, ordinary cotton wicking saturated with common yellow soap may be safely employed. It is best to use soft metal washers. A very good flexible diaphragm for a regulator may be made of closely-woven cotton abric varnished on both sides with a compound of gelatine and glycerine, in equal parts by weight. Wooden vessels and bays may be made petroleum-tight by treating with this preparation. As a rule, all substances that are soluble in water are insoluble in petroleum, but for stuffing-boxes required to stand both water and petroleum, castor-oil lubrication may be used, as this particular oil seems equally insoluble in water or petroleum.

Ventilation with Washed Air.

A remarkable example of artificial ventilation is that of the operating-room of the head office of the Chicago Telephone Company. It appears that serious inconvenience arose in this establishment from the accumulation of dust upon the large switchboard, which constantly interfered with the delicate electric connections. In order to cure this trouble, it was decided to supply the apartment with purified air. With this object air is drawn from without by a fan, which drives it through a chamber where it is thoroughly washed by clouds of water-spray. The washed air is then deprived of superfluous moisture by being passed through centrifugal driers, after which it traverses a chamber where it is warmed or cooled, as required, by contact with pipes filled with either hot or cold water. The air is then conveyed by a shaft to where it is required. The windows of the operating-room are always kept tightly closed and sealed round the edges; and the doors are double—constituting what is virtually an air-lock on every entry. As the air supply is delivered under slight but positive pressure, the tendency is rather for the purified air to escape than for outside air to enter the apartment. The capacity of the delivering-shaft is so calculated that the aërial contents of the room are changed every three minutes. The fresh air is admitted at the ceiling level—the channel running all round the room. The outlets are fixed in the windows; the spent air being drawn from near the floor level by means of tubes closed at the outside with balanced flaps. The system is described as entirely successful, both as an example of ventilation and as a remedy for the mischief of soot and dust. Gas heating is relied upon; the desired temperature being kept to within 2° by means of a thermostat. The total expense of maintaining the system in operation is stated to be less than $100 per month; and in view of the great benefits derivable from such arrangements, it is remarkable that they are not more generally installed in offices and places of business in towns.

An Error in Computing the Delivery of a Water-Main.

An extraordinary tale of municipal mismanagement in respect of water supply has for some time past engaged the attention of readers of the "Engineering Record." It appears that for a number of years Jersey City, in the State of New Jersey, has gone on supplying itself with what is described as the diluted sewage of the water of the Passaic River. which has become every year fouler, and, if possible, more dangerous to health. At last steps were taken to procure a better supply. But difficulties arose and delayed the works, so that it was necessary to obtain temporary assistance, which was offered by a Water Company actually supplying the neighbouring City of Newark. Negotiations were consequently set on foot; and eventually a contract was entered into for the supply by the Company of 50 million gallons of water per day to the water-works of Jersey City. A riveted steel pipe 48 inches in diameter was laid specially to convey this additional supply. But when the water was actually turned on, it was discovered that, instead of furnishing the stipulated quantity, the trunk main would only deliver a maximum of 35 million gallons per day; so that the Company had contracted to deliver to Jersey City alone more than they could get altogether from their source of supply, 26 miles distant. A new main will have to be laid the whole distance; and meanwhile American engineers are greatly exercised as to the allowances that should be made upon the accepted pipe formulæ to compensate for the disturbing effect of different systems of manufacturing and jointing mains. For pipes from 24 to 54 inches in diameter, it is stated to be the Californian practice to allow 20 per cent. additional diameter for riveted pipe, to the diameter calculated from formulæ for smooth pipe.

Simple Furnace-Testing Apparatus.

A description was recently published in "Engineering" of a piece of apparatus for testing the efficiency of furnaces, made according to the patents of Mr. George Craig, of Glasgow, by Messrs. Baird and Tatlock, of that city. It consists essentially of a couple of ordinary wet gas-meters, between which is interposed a vessel containing soda-lime. The furnace gases are aspirated through this system; and as the index of the first meter shows how much gas is taken, while the second indicates how much is left after the carbonic acid has been arrested by the soda-lime, the difference between the meter readings is the measure of the carbonic acid originally present in the gases. As a maximum, this proportion may amount theoretically to about one-fifth of the total. If examination shows the amount of carbonic acid to be much less than this, the inference is that too large an air supply is being admitted to the fires, and the dampers should accordingly be attended to. The simplicity of the whole arrangement is highly creditable to the designer. He mounts the meters and soda-lime box upon the aspirator, which thus forms the stand. But it naturally occurs to suggest that if one of the meters were made after the well-known motive-power pattern, the aspirator might be dispensed with. The meter drums work in paraffin oil.

Misuse of the Term "Pure" by Chemists.

In the course of his address as President of the Chemical Society, Professor Armstrong took the opportunity for protesting against the light and careless way in which the terms "pure" and "to purify" are commonly employed in connection with chemical operations. He spoke satirically of the "almost childlike simplicity of faith and belief in the chemist's ability to purify which distinguish our physical colleagues." He declared that it is time people ceased to speak of substances as pure, inasmuch as a pure substance is, and must ever remain, an ideal conception; and while there can be an infinite number of degrees of impurity, there can be none of purity. The much-misused phrase "chemically pure" has no abstract meaning, and should be discarded, as it is usually nothing more than a convenient fiction, made use of by sellers of chemicals. Professor Armstrong suggested that "purified" should be substituted for "pure." Most chemists are sufficiently serious offenders in this way; but men of other callings are not infrequently guilty of like thoughtlessness. Professor Armstrong concluded his strictures on this head by observing that language, indeed, may be said to be an instrument for the concealment of thought when these abuses of it are possible. Surely, if devoted to science, we should be scientific in all things, and not speak of substances as pure when such a condition of matter is known to be unattainable.

TECHNICAL RECORD.

RESEARCHES ON THE COMBUSTION OF ILLUMINATING GAS IN COOLED FLAMES AND GAS MOTORS.

By Dr. F. HABER and A. WEBER.

(*Continued from p. 563.*)

III.—*Combustion in Flames for Heating Purposes.*

A.—*Collection of the Gas.*

The products of combustion were sampled by means of a funnel-like apparatus devised by Dr. Bunte. Round the boiling-pot is soldered an eaves-like projecting sheet of metal, which forms, with the walls of the pot, a chamber in which the products collect before escaping into the open air. By means of a small pipe in the sloping outer wall, a portion of the products can be drawn through an absorption apparatus. By this simple device, the gases may be sampled without the flame being in any way affected. An aspirator of about 1¼ cubic feet capacity serves to draw the gases through the apparatus; and the volume of unabsorbed gases is ascertained from the weight of water passed from the aspirator. The volume of carbonic acid absorbed is known from the increase in weight of the absorption tube. This, added to the volume of unabsorbed gas, gives the total volume of spent gases aspirated; and on this the proportion of carbonic acid is calculated. The average value so found agrees very well with tests made on samples taken at any given moment.

A Teclu* modified bunsen burner, the tube of which was 16 mm. wide, and the air supply of which could be varied from 0 to 80 per cent., was used. The top of the burner was 18 mm. (about 0·7 inch) below the cold surface. In the burner-tube, between the gas-nozzle and its mouth, was a capillary side-branch, through which samples of the mixture of air and gas were drawn off for analysis. The gas supply was regulated so that the forks of the flame did not reach the collecting space for the spent gases; and therefore the gas was completely burnt before reaching the space. If the flame spread beyond the circumference of the bottom of the pot, incompletely burnt gas was found more abundantly in the products.

B.—*Complete Combustion of the Fuel.*

In the first of the experiments made, the flame was clearly separated into two zones. The green inner cone was limited by the bottom of the vessel above and the mouth of the burner below, so that it had the appearance of a rod connecting the two. The outer violet mantle had a roughly conical shape to within 8 mm. (0·315 inch) of the bottom of the vessel, when it spread out along the surface, quickly diminishing in thickness. The diameter of the circle into which the flame spread on the bottom of the vessel was 10 to 11 cm. (about 4 inches). The dark zone between the vessel and the flame, in which the cooling action of the surface extinguishes the flame, was scarcely perceptible. The results of the experiment are given in Table I. [p. 623.] In the second experiment, the primary air was diminished; and the flame was thereby enlarged to 18·5 cm. (7·3 inches) diameter. There was a reactionless zone of considerable depth between the flame and the bottom of the vessel; and the sharp demarcation between the inner and outer cones of the flame disappeared shortly above the top of the burner. The flame formed a uniform violet stratum underneath the vessel. The results of the experiment are given in Table I., as are also those of the third experiment, in which the primary air was still further cut off, and the reactionless zone was still deeper. The flame was feebly luminous, and deposited tarry matters on the cold surface of the vessel. When the vessel was removed, the flame was unsteady and very luminous. Its diameter could not be measured, as it had lost stability and played to and fro.

It is evident, from these experiments, that the amount of primary air is the most important factor. The quantity of combustible constituents rises, with a diminishing proportion of primary air, from traces to several tenths per cent. The ratio of the atoms C : H teaches us that the combustible contains considerable quantities of carbonic oxide. This result is of such practical importance that the investigation was extended to some ordinary specimens of gas cooking apparatus. These fell into two groups—one comprising those appliances in which a feebly luminous, unsteady flame, without distinguishable cones, arises from a series of openings; the other group consisting of apparatus in which small luminous jets, or discs of flame, with green inner and sharply-defined violet outer cones, are used. Burners of the first group are known as mushroom burners; those of the second, from the name of their first manufacturer, as Wobbe burners. The latter, in the horizontal circular slit pattern, enter into most English and German gas cooking appliances. Fletcher modifies them by using vertical slits; Siemens puts the slits one above the other; and the Dessau and some other forms of apparatus have a ring of small single flames. Two specimens of each type were used for the experiments—viz., mushroom burners, by Leclerq, Fontenau et Cie., of Paris, and Boucher et Cie., of Fumay, and Wobbe burners, by Siemens and Co. and by Junker and Ruh.

The cold vessel and the arrangement of the tests were similar to those for the bunsen burner trials. The primary air determination was made by drawing off a sample of the mixed gas and air, by means of a thin walled capillary, introduced into the mixing chamber just below the mouth of the burner. A blank experiment was made to ascertain the margin of error. The two tests on Boucher et Cie.'s apparatus are instructive, since its construction does not permit any access of sufficient secondary air with a vessel of the size used. This occasions a considerable change in the degree of incompleteness of the combustion, and in the ratio of the atoms of carbon and hydrogen. Evidently there are here the same proportions which led Lewes to his erroneous conclusions. On repeating the experiments with the vessel set higher, the discrepancy vanished; and the combustible constituents of the spent gas appeared in the quantity and atomic ratio corresponding to what the proportion of primary air would lead us to expect.

C.—*Qualitative Tests on the Combustible Constituents of these Spent Gases.*

Carbonic oxide was present in quantity sufficient for the test with diluted blood to be the most suitable. The bunsen burner was in the usual position under the cool surface; and the primary air formed 30 per cent. of the mixture. Two concordant tests gave 6 per cent. of carbonic acid in the spent gases. About 15 litres of the spent gas was drawn through a Winkler's coiled tube containing solution of potash, and through a reagent glass containing some diluted blood. Spectral examination of the blood alongside fresh blood, before and after treatment with ammonium sulphide, very distinctly indicated the presence of carbonic oxide.

For the detection of free hydrogen, Philipps's process was used. This is based on the fact that in gases free from oxygen, uncombined hydrogen alone has the power, when dry, of setting free hydrochloric acid from pure dry palladium chloride. The burner was placed as in the test for carbonic oxide. The gases were washed with solution of potash, and kept for several days over phosphorus, for the complete absorption of oxygen. They were then dried, by means of sulphuric acid and phosphorus pentoxide; and then led over palladium chloride ($PdCl_2$), warmed to 50° C. in solution of silver. The reaction was feeble, but unmistakable. It was ascertained that neither carbonic acid nor the spent gas similarly treated, but not passed over the palladium chloride, produced cloudiness in the solution of silver.

There is no delicate test for olefines in the presence of carbonic oxide and hydrogen; and hundredths per cent. would therefore remain undetected. They were not present in sufficient quantity in the spent gases to affect the absorption of oxygen by phosphorus. It was found that this absorption was hindered in air by the presence of 5 per cent. of gas containing about 0·17 per cent. of ethylene (*cf.* "Hempel's Gas Analysis," by Dennis, p. 124). Benzol does not affect the absorption of oxygen by phosphorus.

Acetylene was simultaneously tested for, both qualitatively and quantitatively. Carbonic acid was removed from the spent gases by dry reagents (solutions of potash and soda retain acetylene); and the gases were then led through three absorption vessels, protected from the light, and containing ammoniacal solution of silver. The vessels were connected to the collecting vessel, which naturally was only put out of action after the ammonia had been absorbed from the gaseous residue by sulphuric acid.

Determinations of Acetylene in the Spent Gases from a Cooled Bunsen Flame.

Percentage of Primary Air.	Percentage of Carbonic Acid in Spent Gases.	Acetylene (C_2H_2) in Spent Gases in Parts per Thousand.	Combustible Gas in the Spent Gases in Parts per Thousand (interpolated from Tables I. and II.)	Percentage of Acetylene in the Combustible Portion of the Spent Gases.
33·49	5·8	0·11	6·50	1·67
30·62	5·8	0·10	6·50	1·62
19·14	6·2	0·19	7·34	2·60
20·57	5·0	0·23	7·34	3·09

Acetylene therefore is present, but only forms a small percentage of the total combustible constituents.

D.—*Fractional Combustion.*

Fractional combustion was very difficult in this case, owing to there being small quantities of carbonic oxide along with the hydrogen and hydrocarbons. In a preliminary test, only a little was consumed at 360° to 380° over a palladium wire coil.

With the primary air 31·1 per cent., the proportion of carbonic acid (*a*) in the spent gases was 7 per cent., and the weights (*c*) found were: Carbonic acid before the coil, 1·6654; after the coil—

I. { Carbonic acid . . . . 0·0497
   { Water . . . . . 0·0055

After the platinized asbestos tube—

II. { Carbonic acid . . . . 0·0865
    { Water . . . . . 0·0125

The degree of incompleteness (*d*) was 7·56; the ratio of the atoms carbon to hydrogen in I. (*e*) as 1 : 0·541; in II. (*f*) as 1 : 0·707. From the sum of I. and II. (carbonic acid, 0·1362; water, 0·0180), the ratio of those atoms (*g*) was as 1 : 0·646.

* See "JOURNAL," Vol. LXII., p. 849.

TABLE I.—*Experiments with a Bunsen Burner with Teclu's Air-Supply Regulator.*

No. of Experiment.	Gas Consumption per Hour in Cubic Feet.	Gas Pressure in Tenths of an Inch.	Percentage of Primary Air.	Percentage of Carbonic Acid in Spent Gases, Estimated by Burette.	Carbonic Acid before the Combustion Apparatus in Grammes.	Carbonic Acid after the Combustion Apparatus in Grammes.	Grammes of Carbon.	Water Found after the Combustion Tube in Grammes.	Grammes of Hydrogen.	Volume of Gaseous Residue, at 0° C. and 760 mm., in Cubic Centimetres.	Calculated Percentage of Carbonic Acid in the Spent Gases.	Degree of Incompleteness of the Combustion.	Ratio of the Atoms C : H.	Unconsumed Gas, as Carbonic Oxide, Calculated from Col. 6, in Parts per Thousand.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I.	9·82	11·8	79·57	—	2·8411	0·0189	0·0013	0·0061	0·0007	21,595	6·3	0·66	—	0·4
II.	9·71	11·4	66 50	5·8	2·7894	0·0966	0·0263	0·0091	0·0010	21,413	6·2	3·35	1 : 0·4601	2·3
III.	9·78	11·4	21·77	6·7	3·2481	0·2573	0·0702	0·0432	0·0048	25,580	7·6	7·64	1 : 0·8206	7·3

TABLE II.—*Experiments with Gas Cooking Apparatus.*

I.	5·37	11·8	76·12	7·4	2·8510	0·0256	0·0070	0·0032	0·0004	18,099	7·4	0·89	—	0·7
II.	8·19	7·9	74·36	6·2	2·7810	0·0113	0·0031	0·0052	0·0006	19,770	6·7	0·40	—	0·3
III.	—	7·5	58·28	—	2·8050	0·1766	0·0460	0·0224	0·0025	19,184	7·0	5·92	1 : 0·6228	4·7
IV.	7·95	—	51·63	—	2·9729	0·6316	0·1722	0·2100	0·0233	20,458	7·8	17·52	1 : 1·6254	15·7
	"	—	"	—	3·1656	0·2209	0·0602	0·0330	0·0037	20,819	7·7	6·52	1 : 0·7323	5·5
*	—	—	—	—	0·0420	0·0043	—	0·0050	—	24,912	—	—	—	—

NOTE TO TABLE I.—The Drehschmidt capillary served as the combustion apparatus. Tarry products were formed as soon as the amount of primary air became small. They were partially deposited on the cool surface, and partially carried away in the current of gas. The tarry particles in the gas were retained in the unweighed coil used for drying the gas before it entered the carbonic acid absorption apparatus, and coloured the first portions of the sulphuric acid red to yellowish brown.

NOTE TO TABLE II.—The combustions were carried out in a Drehschmidt capillary apparatus. The appliances experimented with were those of the following firms: (I.) Messrs. F. Siemens and Co. (German patent No. 78,156); (II.) Messrs. Junker and Ruh (registered pattern, No. 25,681); (III.) MM. Leclerq, Fontenau, et Cie., Paris; (IV.) MM. Boucher et Cie., Fumay. * This was a blank experiment on aspirated air.

The volume of the gaseous residue (*h*) was 10·864 litres at 0° C. and 760 mm.; and the test lasted (*i*) eight hours.

The degree of incompleteness and the ratio of the atoms (*g*) are in accordance with earlier results. The ratios (*e*) and (*f*) point to the presence of a difficultly combustible hydrocarbon. A second experiment, in which the coil was heated in boiling sulphur, further proved its existence. In this test there was 25·84 per cent. of primary air, the carbonic acid in the spent gases was (*a*) by the burette 4·9 to 5·1 per cent.; or (*b*) from the volume and the weight of carbonic acid, 5·26 per cent. The weights (*c*) found were: Carbonic acid before the coil, 1·8771; after the coil—

I. { Carbonic acid . . 0·1055 ; Water . . . . . 0·0069 }
After the platinized asbestos—
II. { Carbonic acid . . 0·0140 ; Water . . . . . 0·0087 }
= { Carbonic acid = 0·1195 ; Water . . . = 0·0156 }

The degree of incompleteness (*d*) was 6·0; and the ratio of the atoms carbon to hydrogen in I. (*e*), as 1 : 0·32; in II. (*f*), as 1 : 3·04; and in the sum of I. and II. (*g*), as 1 : 0·638. The volume of the gaseous residue (*h*) was 17·197 litres at 0° C. and 760 mm.

This leaves no doubt that a highly hydrogenized hydrocarbon is present along with the carbonic oxide and hydrogen. The numbers found after the second combustion tube are too small to permit of safe deductions, in the face of possible experimental errors; but it is probable that methane and acetylene are present. Acetylene is burnt with such difficulty, that its combustion products would first be found after the platinized asbestos tube. Its presence has been demonstrated in Section C. Methane is probably present, because it is the most difficultly burnt constituent of coal gas, and traces can most easily escape from an obstructed flame; and also because no other constituent, and no product of imperfect combustion, could raise the ratio of the atoms after II. above 1 : 2. Calculating the found weights of carbonic acid and water before the coil to carbonic oxide and hydrogen, and those after the coil to methane and acetylene, the following are the percentages by volume in the spent gases: Carbonic oxide, 0·296; hydrogen, 0·047; acetylene, 0·010; methane, 0·015.

The figure for methane is, as already stated, unreliable; but it serves to show how inconsiderable are the other constituents beside the carbonic oxide. The figure for acetylene is supported by direct determinations made in the course of the gas-motor investigations described later. A check experiment, for the determination of carbonic oxide and hydrogen only, gave the following figures: Percentage of primary air, 32·15; carbonic acid before I., 1·6016; after I., 0·0981; water after I., 0·0033; carbonic acid in the spent gases, 6·0 per cent.; gaseous residue, 12·845 litres; ratio of carbon to hydrogen atoms after I. as 1 : 0·1645. The percentages by volume on the spent gases (calculated) were: Carbonic oxide, 0·36; hydrogen, 0·03.

The results of both tests agree with the conclusions drawn from the qualitative tests. The carbonic oxide reaction with blood presupposes more than 0·25 per cent. of that gas, when it occurs vigorously, as was the case here. The hydrogen reaction of Philipps—which did take place, though feebly—is, according to its discoverer, not observable with less than 0·02 per cent.

E.—*Conclusions from the Experimental Results.*

There are only traces of combustible gases other than carbonic oxide, hydrogen, and acetylene. These are the typical products of combustion with less than the amount of air requisite for perfect combustion. There was no obstruction to the secondary air supply; and consequently sufficient was present to consume all combustible particles of gas. When consumption is, therefore, imperfect, the explanation must be that certain combustible particles are already too cold to be oxidized by the oxygen when they come into contact with the requisite amount of air. This cooling down of the particles below their temperature of oxidation is brought about by the influence of the cool surface. The hotter and smaller the flame, the less is the influence of the cool surface. The zone between the flame and the bottom of the vessel, where there is no combustion, is then very shallow. The gaseous particles are forcibly cast against the cool surface, rebound, and are twirled back into the flame, where they are again highly heated. The result is that on the margin of the flame the particles are nearly all sufficiently hot for combination with the oxygen which abounds there.

The flame enlarges as the primary air is diminished; and the depth and extent of the reactionless zone increase with it. The gaseous particles then reach the flame again with difficulty—on the one hand, because the cooled zone is thicker; and, on the other, because the motion of the particles towards the margin is surpassed by their whirling backwards and forwards horizontally. The number of particles which reach the margin of the flame too cold for combination with the atmospheric oxygen increases; and then considerable quantities of combustible constituents escape with the spent gases. Under such very unfavourable conditions, only the merest traces of unchanged constituents of the original coal gas—such as methane—are found. Thus the constituents of the coal gas find in all cases as much oxygen as is required for their conversion to carbonic oxide and hydrogen; but nevertheless they are cooled below the temperature of combustion. The fact that combustion takes place by steps—as Smithells, Ingle, Dent, and Lean and Bone have explained in various cases—is quite in harmony with this fact. (The statements of Lewes, referred to in the introduction, are thereby refuted.)

The combustible parts of the spent gases contain very much carbonic oxide and little hydrogen, for hydrogen is burnt at a lower temperature than carbonic oxide, as the experiments of Mallard and Le Chatelier have certainly established. The experiments now carried out lead to the following practical conclusion: Flames playing on cold surfaces produce quantities of carbonic oxide of serious hygienic importance only when the proportion of primary air is too low. Gas cooking apparatus with low primary air supply is therefore to be avoided. Only traces of carbonic oxide are formed when the primary air supply is large; and they are of no importance from any point of view—especially that of economy.

(To be continued.)

THE COMBUSTION OF COAL AND GAS IN HOUSE FIRES.

In the "JOURNAL" for the 4th ult. (p. 221), we noticed briefly a paper on the above subject read by Dr. J. B. COHEN, Lecturer in Chemistry at the Yorkshire College, Leeds, and Mr. G. H. RUSSELL, A.I.C., before the Yorkshire Section of the Society of Chemical Industry. We have since received from the authors a reprint of the paper, which appears in the current number of the Society's "Journal;" and we are therefore now in a position to deal with it more fully.

The authors begin by explaining that the object of the experiments described by them was, in the first place, to determine once more the extent of pollution of town air by smoke arising from house fires burning coal; and, secondly, to ascertain whether a more extensive use of gas-fires might be recommended by way of mitigating or removing the evil.

Beginning with coal-fires, a few determinations of the quantity of soot given off from a good quality of Yorkshire house coal (silkstone hards) were made by Mr. G. Hefford, and appeared in a paper prepared by him in conjunction with Dr. Cohen, which appeared in the Society's "Journal" in February, 1893. Cotton-wool plugs were employed for collecting the soot from the fire. Subsequently one of the authors found that the exceedingly hygroscopic character of cotton wool might, in view of the small quantity of soot in proportion to that of the wool, lead to appreciable errors unless dried and weighed with special precautions. Another source of error in the former determinations might have arisen from the fact that the carbon dioxide in the chimney gases was determined in samples drawn occasionally, and might therefore not accurately represent the average amount of carbon dioxide passing up the chimney during the whole period of combustion. It was consequently thought desirable to repeat the determinations, so as to avoid these possible sources of error, and to extend them so as to include house coal from the Durham and Lancashire coal-fields.

The results arrived at may be summarized as follows: Using a similar kind of coal to that employed in the former determinations, the weight of soot per 100 litres of chimney gases and the percentage of carbon dioxide were both found to be much lower than on the previous occasion. The net result was to raise the percentage of soot on the carbon burnt from 5 to an average of 7·7 with this particular quality of coal. The average quantity of soot in twelve analyses, including eight of Yorkshire coals, two of Durham coals, and two of Wigan coals, amounted to 6½ per cent. on the carbon burnt. The quantity of soot obtained in different experiments with the same kind of coal varied; being no doubt influenced by the manner of firing and by the amount of draught. There was no slack in any of the samples. The results of the experiments are tabulated.

Turning to gas-fires, the authors remark that the use of gas in place of coal has often been suggested as a remedy for the smoke nuisance; and they allude to the fact that many people profess an objection to gas-fires, either from experiencing a real feeling of discomfort, or from purely sentimental reasons. It has been alleged, moreover, that carbonic oxide is given off into the room from gas-fires—a statement which, if true, would manifestly condemn their use. They point out that it is impossible to ascertain or explain the cause of, and therefore to controvert, sentimental objection; but the other matters may be easily tested—*i.e.*, as to the evolution of carbonic oxide, and as to the cause of physical discomfort. The authors had three different kinds of gas-stoves placed at their disposal; and they were able to make a rough comparison between them and coal-fires, as regards heating effect from the point of view of economy and health. They likewise had full permission from the makers of the stoves to publish the results, whether or not they were prejudicial to their interests.

With regard to carbonic oxide, the authors state briefly that there is practically no carbonic oxide passing from a gas-fire—*i.e.*, the volume does not amount to 0·01 per cent. of the flue gases with the full pressure of gas, and burning from 42 to 44 cubic feet an hour. When the gas was first lighted with slight explosion, and the gases were immediately aspirated for about two minutes from the front of the fire above the clay rings, an average of 0·9 per cent. of carbonic oxide was found. Gases aspirated from within the clay rings contained, on an average, 10·5 per cent. of carbonic oxide. The authors attach no importance to this, as, from experiments made at the Yorkshire College, samples of gases could be drawn from the interior of a coal-fire containing as much as 6 per cent. of carbonic oxide, none of which, with a reasonable chimney, ever found its way into a room. With a down-draught, unburnt hydrocarbons and carbonic oxide may be wafted into the room from a gas-fire, and probably also from a coal-fire.

The authors record in a series of tables the results of their preliminary examination of the gases from the gas-fires with Hempel's apparatus, by the palladium chloride and the hæmoglobin tests; the quantitative determination of the amount of carbonic acid and carbonic oxide in the flue gases; and the analyses of the gases drawn from the middle of the fire and from above the clay rings immediately after lighting. The results of six experiments on gases from the middle of the fire were as follows: Percentage of carbonic acid (determined by Hempel's apparatus), 5·07; percentage of carbonic oxide, 13·81, 14·02, 12·65, 0·935, 15·74, 5·43. In the case of the gases taken from above the clay rings, four experiments gave the following percentages: Carbonic acid, 2·6, 6·6, 3·0, 1·4; carbonic oxide, 1·0, 1·7, 0·6, 0·4.

Coming to the portion of the paper giving a comparison of the heating effect of gas and coal fires, the authors made determinations with special reference to the following points: (1) Rise of temperature of the air in different parts of the room; (2) heating effect by radiation; (3) dryness of the air; and (4) draught into the chimney.

The gas-stoves tested were of various kinds; and they are designated by letters.

The special feature of stove A is a perforated top, through the cylindrical apertures of which a constant circulation of air is effected, which then passes into and helps to warm the room. Stove B is similar to A, but without a perforated top. In both A and B, the body of the stove is fixed in front of the old fire-grate, and the hot metal will assist more or less in warming the air. Stove C is a new form of gas-fire. It has eight instead of six atmospheric burners, as in A and B, but of rather smaller dimensions, and clay rings; but it is fixed back in the old fireplace, and delivers not only its combustion products directly into the chimney, but the warm air from the hot metal also passes up. Further, it has a reflex and not a vertical fire-clay back, which is much longer than in A and B. It is, in short, a shallow coal fire-grate burning gas and heating by radiation like a coal-fire. Stove D is the ordinary old-fashioned coal fire-grate, with vertical back, and with both back and sides above the grate of cast iron. In moderately cold weather, it consumes about 2 lbs. of coal per hour. With hard firing, this quantity would be doubled. The coal used was Haigh Moor best. The gas-fires A and B and the coal-fire were tested on the same day, and under approximately the same conditions. Gas-fire C (which had not then been made) was tested on a later date along with B and the coal-fire. The full details of the experiments will be found in the subsequent tables. The authors give the following brief summary of their results:—

Draught.—The chimney draught plays an important part in the heating of a room; and we will first refer to this. Although there is a rapid current of air, sufficient to extinguish a lighted taper, through the narrow exit into the flue of the gas-stoves A and B, which delivers the products of combustion to the chimney, the amount of air from the aperture only passes at the rate of about 3½ cubic feet per minute, measured by an anemometer. The flow of air towards the front of a gas-stove was in these two cases so slow as to give no indication whatever with the anemometer. Consequently, if the chimney space behind the gas-fire is blocked up, except for the flue-pipe, there is practically no ventilation of the room by way of the chimney. On the other hand, if the chimney is not blocked, the current of air in cubic feet per minute is as follows:—

	Door of Room Closed.	Door of Room Open.
A, burning 22 to 23 cubic feet of gas	105	123
B " " " "	133	166
C " 20 " "	132	160
D " 2 to 3 lbs. of coal small fire	160	180
D " 2 to 3 lbs. of coal large fire	200	235

Rise of Temperature of the Air.—The average rise of temperature in degrees centigrade, indicated by thermometers (previously compared), and distributed through the room, was as follows:—

	First Hour.	Second Hour.	Third Hour.	Cub. Ft. of Gas Burnt.
A, Jan. 3, 1896	1·82	2·31	—	22½
B "	1·66	1·81	—	20
D "	1·00	1·37	1·4	— Moderately fired.
B, Jan. 19, 1896	2·2	2·60	—	24
C "	1·4	1·60	—	19
D "	0·7	2·00	—	— Strongly fired.

The sets of experiments on the two days are not comparable, as the initial temperatures were very different; and the rise from the lower temperature in the second set was greater than in the first. As the room is over the kitchen, and gets a certain amount of heat from below, what was thought the least effective heating apparatus was tested last.

Dryness of the Air.—The first set of experiments were made when the outside air was nearly saturated with moisture (temp., 10·5; wet bulb, 9·75). The difference between the wet and dry bulb thermometers in the middle of the room increased with the rise in temperature of the air. The difference, as mght have been anticipated, was greatest in the case of A and B in the first, and B and D in the second set. The difference between the wet and dry bulbs is shown in the following table:—

	Degrees.		Degrees.
A	5·0	B	5·3
B	5·0	C	4·2
D	4·5	D	5·2

Heating Effect by Radiation.—This was determined by suspending thermometers 3 feet from the fire at a height of 1 foot and 3 feet above the ground. There was little difference between the gas-fires and a bright coal-fire, except that the temperature was always rather higher near the floor than 3 feet above in the case of the gas-fire, and often the reverse with the coal-fire. With an ordinary coal-fire, a much lower temperature

was obtained than with the gas-fire when burning from 20 to 23 cubic feet an hour.

	1 Ft. above Ground.	3 Ft. above Ground.	
B	24·4	22·6	22 to 23 cub. ft. per hour.
C	23·0	22·0	20 ,, ,,
D	24·5	24·5	Bright fire.
	19·5	20·2	Rather dull fire.

With regard to the gas-fire experiments, the following particulars are given: The room measured 14 ft. by 14 ft. by 10 ft. high, and, in addition, had a small bow window. The thermometers were compared for correction and distributed as follows: (*a*) Middle of the room, 3 feet from ceiling. (*b*) Middle of the inside side wall, 4 feet from floor. (*c*) Middle of the room, 4 feet from floor; wet and dry bulb. (*d*) Middle of outside side wall, 4 feet from floor. On Jan. 3, 1896, wet and dry bulb outside indicated at midday—wet, 9·75°; dry, 10·5°. The temperature outside varied during the day from 10° to 11°. One person was in the room during all the experiments. The temperatures given are in degrees centigrade.

Stove B.

Time.	*a.*	*b.*	*c.* Dry Bulb.	*c.* Wet Bulb.	*d.*	Consumption per Hour.
						Gas.
6 a.m.	18·00	18·1	18·25	14·25	18·2	—
7 ,,	20·10	19·5	20·60	15·60	19·0	20 cub. ft.
8 ,,	20·30	19·7	20·60	15·60	19·2	20 ,,

The room was allowed to cool two hours, and the stove changed.

Stove A.

10 a.m.	18·00	17·7	17·70	13·90	17·7	—
11 ,,	19·60	19·4	20·40	15·50	22·2	22·5 cub. ft.
12 noon	20·25	20·0	20·70	15·70	19·4	,,

The room was again allowed to cool, and the coal-fire lighted.

Coal-Fire.

						Coal.
2.30 p.m.	18·25	17·5	17·75	14·0	17·7	About 6 lbs. burnt in three hours.
3.30 ,,	19·30	18·7	19·20	15·0	18·2	
4.30 ,,	19·60	19·2	19·60	15·5	18·5	
5.30 ,,	20·00	19·2	20·00	15·5	18·8	

Jan. 19, 1896.—Outside temperature varied from 11·7° to 6·5° during day.

Stove C.

						Gas.
5.45 a.m.	15·8	15·5	15·3	11·5	15·3	—
6.45 ,,	17·4	16·6	17·2	13·0	16·3	19 cub. ft.
7.45 ,,	17·7	16·7	17·4	13·2	16·5	19 ,,

Stove B.

10.35 a.m.	15·4	15·0	14·6	10·7	15·0	—
11.35 ,,	17·5	17·2	17·6	12·5	16·6	24 cub. ft.
12.35 p.m.	17·9	17·4	17·8	12·5	17·3	24 ,,

Coal-Fire.

						Coal.
2.30 p.m.	15·8	15·4	15·3	10·8	15·5	About 6 lbs. burnt in two hours.
3.30 ,,	16·7	16·3	15·8	12·0	16·1	
4.30 ,,	17·9	17·5	17·8	12·6	17·0	

The conclusions arrived at by the authors from their experiments may be briefly stated as follows: (1) The draught up the chimney plays an important part in the heating of a room. (2) If the fireplace behind the gas-stove is closed, except for the flue-pipe, the greatest heating effect is produced; but there is then practically no ventilation by way of the chimney, unless by a special opening into it. (3) If the fireplace behind the gas-stove is open, the draught up the chimney is considerable; but rather less than with a coal-fire. (4) In the last case the heating effect with gas-stoves A and B is still greater than with the coal-fire—*i.e.*, the air of the room is warmed more quickly and to a higher temperature than with the coal-fire. (5) The heating effect of a gas-fire of type C is less than that of a coal-fire. (6) As regards relative cost in Leeds, roughly speaking, gas is three times as costly as coal, comparing equal periods of heating; but, as regards heating effect, the cost of gas will be proportionately less. It is doubtful, even then, if gas is less than twice as expensive as coal.

The authors think there is no doubt that a higher heating effect with coal may be attained in modern modifications of the coal-fire on the "reflex" or "lean-to" back principle, with small flue aperture; but they had no opportunity of testing this. In the case of a coal-fire, the heating is mainly done by radiation; and the air of the room is only slowly warmed by contact with walls, ceiling, &c.—reaching, after a time, a maximum, as is seen in the experiment on Jan. 3, when, during the third hour, no appreciable rise of temperature occurred. With gas-stoves A and B, on the other hand, the air gets rapidly warmed. It is therefore necessary to guard against over-heating of the air by ascertaining the temperature from time to time and adjusting the gas; for air warmed above a certain temperature is apt to cause a feeling of dryness and discomfort. If the fireplace behind the gas-fire is closed so as to get the maximum heating effect, some opening into the chimney should be contrived by making an aperture at the ceiling-level. If the above conditions are observed, a gas-fire is a perfectly healthy heating appliance, more effective and more cleanly, although at the same time more costly, than coal. It must be remembered that these experiments on the comparative heating effects of gas and coal fires, although carried out with as much care as the circumstances allowed, do not pretend to absolute accuracy. The authors believe that the general conclusions are correct.

In the discussion upon the paper, the Chairman (Mr. T. Fairley) said it was difficult to make comparisons of the heating effects of the different fires on the same day, as the walls and other parts of the room accumulated heat slowly, and only gave it out again slowly; thus tending to increase the effect in the later experiments. Much greater care was needed in the ventilation of a room heated by a gas-fire than when coal was used, owing to the smaller volume of air drawn through the room in the former case. He had found this volume about ten times that of the gas burnt; while Dr. Cohen only found it about six times. Professor Smithells said the subject before the meeting was one on which definite information was much needed. He had always been sceptical about the escape of carbonic oxide from gas-fires; but there was unquestionably a difference in the hygienic effects of gas and coal fires. There was little doubt that where a flame burnt in contact with a cold surface, a certain amount of the gases escaped complete combustion; but in a gas-fire, where the combustion was in contact with a heated surface, this could hardly occur. Dr. Cohen, in reply to the Chairman, stated that he had purposely favoured the least efficient heating apparatus—viz., the coal-fire—by placing it last. Referring to Professor Smithells' remarks, he pointed out that the figures which he had obtained showed that a gas-fire, when the fireplace behind it was not closed up, caused a flow of air through a room which was not very much smaller than that caused by a coal-fire. The difference in their hygienic effects was more probably due to the fact that the heating effect of a coal-fire reached a comparatively low maximum; while with a gas-fire the temperature might be raised much higher. He thought it was rather a grave error to regard a coal-fire as an efficient ventilating apparatus. In the first place, it produced a much more rapid exchange of the air in the room than was generally necessary; and, secondly, this exchange was mainly near the ground, causing disagreeable draughts, instead of at the ceiling, where the ventilation was really needed.

Gaseous Combinations.—MM. Gautier and Helier have been investigating some of the conditions which govern gaseous combinations. By circulating the gaseous mixture through a porcelain tube packed with porcelain rods, kept at a constant temperature, and then passing the products over tubes containing phosphoric anhydride, combination can be shown to occur at 180° C., explosions not taking place until about 840° C.

Gases as Illuminants.—This was the subject of a paper read before the King's College Engineering Society on the 13th inst., by Mr. Sodean, B.S.C. The author commenced his paper by explaining the action which takes place in the several parts of an ordinary gas-flame. The thermo-couple was explained in detail, and its use in determining approximately the ranges of temperature of the various portions; and figures were given showing these temperatures. The flame of acetylene gas was exhibited; and its richness in carbon was demonstrated by experiments made with the ordinary bunsen burner consuming coal gas with varying proportions of acetylene. The manufacture of acetylene from calcium carbide was gone into thoroughly, and the cost of manufacture was discussed at some length.

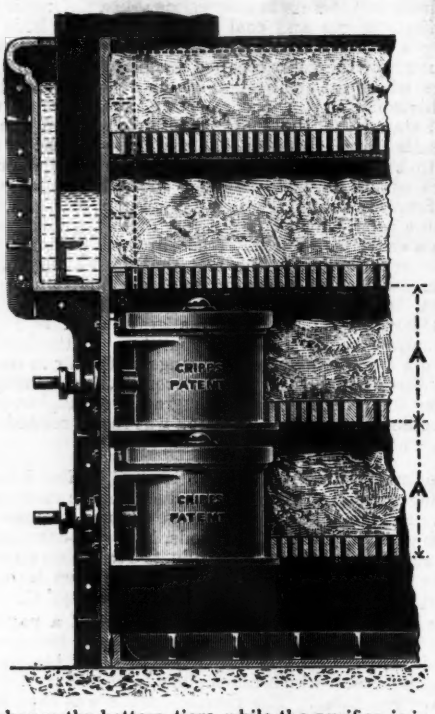
Gas and Electric Lighting in the City Streets.—The Engineer to the Commissioners of Sewers (Mr. D. J. Ross, M.Inst.C.E.) has presented his report on the works executed by the Commissioners in the past year. With regard to public lighting, the number of gas-lamps now paid for is 1854; the consumption ranging from 5 to 50 cubic feet per hour, for 4300 hours per annum, and the charge (at 2s. 3d. per 1000 cubic feet), including lighting and repairing, from £3 6s. 4d. to £25 13s. 9d. per lamp. The 36 meters attached to the lamps in various parts of the City showed that the full contract quantity of gas was being furnished to these lamps; and the Inspector of Gas Lighting, as well as the Inspectors of Pavements, are of opinon that the stipulated quantity of gas is given generally throughout the City, and that the regulators are kept in proper condition. At the close of last year, there were 485 arc lamps in use in the principal thoroughfares; and arrangements have been made for lighting some of the minor streets. Concurrently therewith, the Commissioners have decided to make an experiment in Wood Street with incandescent gas-burners. Both gas and electric lamps were brought into use during the past year whenever fog or unusual darkness came on. This, however, occurred on only six occasions.

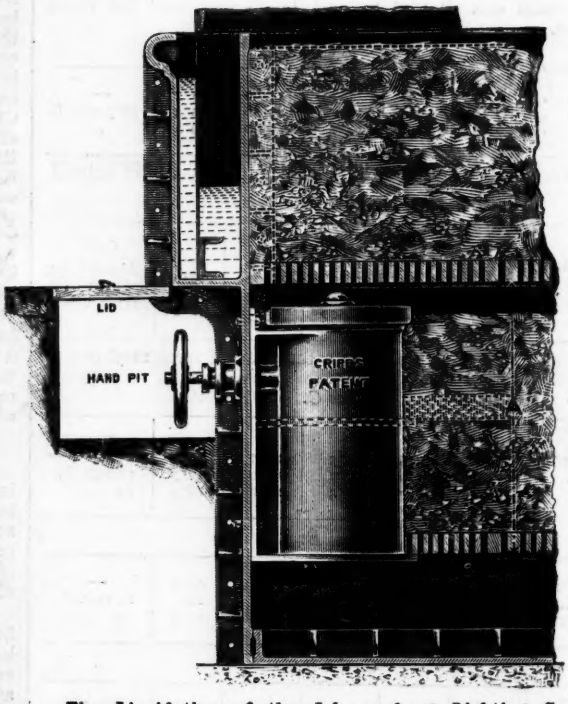
IMPROVEMENTS IN WORKING GAS PURIFIERS.

After certain operations have developed by slow degrees into an established practice and into stereotyped rules, they are frequently accepted without question by those who wish to pass through life easily, and not to ascertain the why and the wherefore of things around them. People generally (and some gas managers are no exception to the rule) are willing to base their operations, without question, on the statements and experience of others who have gone before them; and where a whole community has accepted one particular system of working, the individual is tempted to adopt that system, on the principle or law of the "survival of the fittest." This is, on the whole, a wise course to pursue; but we may sometimes ask ourselves with advantage: "Why are we following in the old ruts?" What is the principle underlying the practice we embrace? Have we stopped short of perfection; and, if so, can we not make a step farther ahead?

Take for example the purification of gas. How is it we come to have several purifiers, occupying much ground space in a gas-works, when, at first sight, it might appear that one or two of greater depth would be sufficient? In other words, instead of having four purifiers with four tiers of grids in each, why not have two purifiers of double the depth with eight tiers in each? Of course, the objection to such a proceeding is sufficiently obvious. Apart from sundry inconveniences unnecessary to mention, the lower tiers of sieves would become fouled and choked long before the upper ones were ready for changing, and the lower ones could not be changed without first taking the top ones out to afford access to them; so that much labour and time would be thrown away in changing the tiers which are not ready for it, in order to get at those that required this operation. Consequently, we find it has become the practice to divide the total number of tiers required into several boxes containing a few each, so that, instead of changing eight or more layers of purifying material at one time, it is only necessary to change (say) four.

But it must be observed that though this dividing up of the number of sieves into several purifiers instead of one or two is a great saving, it only partly meets the difficulty, and is only a saving in degree. If one purifier fouls or chokes before another, so does one layer before another in each box; the consequence being that all the layers in a purifier have to be frequently changed for the sake of the lowest ones only. The bottom tiers may set hard and cake, and so cause excessive back-pressure, long before the top tiers are exhausted or used up. Hence, if any means can be devised for changing the lower tiers without interfering with the upper ones, or for bye-passing either of the lower tiers and passing the gas through the upper ones only, it would enable the top tiers to be completely worked off, and full advantage taken of the purifying material before changing it. A few moments' consideration will serve to show that a saving must result, because instead of taking out the top tiers when they are only half exhausted, they would go on working for a longer time before the purifiers would need changing.





To change the bottom tiers while the purifier is in action or without removing the top ones first is impossible; but to fix a bye-pass valve in the lower trays so that the gas may pass by the lower tiers and enter the upper layers of purifying material only, is quite practicable. Last year, Mr. F. S. Cripps brought out a simple and effective valve for this purpose, which can be as readily fitted to old as to new purifiers; and we learn that it has been adopted by several gas companies. It was brought to the notice of gas engineers generally by the President of the Incorporated Institution of Gas Engineers (Mr. C. C. Carpenter) in his Inaugural Address last May; and it was described and illustrated in the "Register of Patents" in the "JOURNAL" for June 11. The accompanying illustrations show the valves in position. They are actuated from the outside, and are so designed that at no time, whether open or shut, is a surface or working part exposed to the gas uncovered or unprotected from grit and dust. The valve is always kept tight up to its face; and there are no working screws or complicated parts to rust or get out of order.

The Carbides of Yttrium and Thorium.—This was the subject of a recent communication to the Academy of Sciences by MM. Moissan and Etard. The authors found that yttrium carbide, prepared in an electric furnace, is attacked readily by the halogens, with difficulty by acids. With water, the carbide yields a mixture of acetylene (72 per cent.), methane, ethylene, and hydrogen, together with a small quantity of liquid hydrocarbons. Thorium carbide, produced by a similar method, forms a crystalline transparent mass, and gives a mixture of hydrocarbons on treatment with water of the same qualitative composition as that obtained from yttrium carbide.

The Liquidation of the Johannesburg Lighting Company, Limited.—The Liquidator of the above-named Company (Mr. J. Taffs) has notified that the cash available for final distribution will admit of a return to the ordinary shareholders of 1s. 11d. per share, making 5s. 11d. in all. This is 11d. in excess of the original estimate.

The London County Council and the South Metropolitan Gas Bill.—The result of the proceedings at the meeting of the London County Council on the 10th inst., as reported in the "JOURNAL" last week (p. 582), has not, it seems, removed altogether the possibility of opposition by that body to the Bill of the South Metropolitan Gas Company. At the meeting of the Parliamentary Committee on the following Thursday, the Clerk of the Council was instructed to give the necessary public notice that the Chairman (Mr. T. M'Kinnon Wood) intended to bring the subject forward again on the 24th, and that he had the support of more than twenty other members of the Council.

The World's Coal Production.—A statement from the Board of Trade, showing the production of coal in the principal countries of the world in each year from 1883 to 1894, so far as the particulars can be stated, has lately been issued. In 1894, the United Kingdom produced 188,277,000 tons; Germany, 76,741,000 tons; France, 26,964,000 tons; Belgium, 20,534,000 tons; Austria, 9,573,000 tons; Japan (1893), 3,371,000 tons; and the United States, 152,448,000 tons. Of the British possessions, Canada produces between 3,000,000 and 4,000,000 tons; New South Wales, about 3,500,000 tons; and New Zealand yields over 500,000 tons per annum. Natal's output rose from 26,000 tons in 1889 to 141,000 tons in 1894. Similarly in British India the production has steadily risen from 1,316,000 tons in 1883 to 2,821,000 tons in 1894.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

The Water Board Bill.

SIR,—There appears to be a disposition on the part of the London Water Companies to regard the Metropolitan Counties Water Board Bill as leading to a termination of their troubles and anxieties; and I observe that, in your last article on "Water and Sanitary Affairs," it is looked upon as "distinctly contemplating the purchase of the Companies." This latter view is, no doubt, correct. Having regard, however, to clauses 4 and 5 of the Bill, which contain special powers to *worry*, it is doubtful if the Companies will have reason for rejoicing should the Bill become law as it stands; the probability being that those powers will be fully exhausted before the powers to purchase are brought into use.

If the Companies are in a position to press for some modification of the clauses containing powers to worry, it is to be hoped that they will not stand by and allow the Bill to pass without protest, in the hope that inaction may help them to float to a painless dissolution. Such a course will, in my opinion, lead to an intermediate state of existence which I need not further indicate.

March 20, 1896. A. J. A.

The Recent Accident to a Gasholder at Gothenburg.

SIR,—I thank you for the space kindly granted in the "JOURNAL" to the notice of our accident; and I now beg to answer the inquiries, made by Mr. D. Coats Niven, of Calcutta (*ante*, p. 517). We have not yet any idea as to what can have tilted the holder at its full height, and caused the uncupping.

1.—The width of the cup is 12 inches; the depth, 16½ inches inside.

2.—There are 16 rollers, 15 inches in diameter, and 3½ inches wide, attached to the crown of the inner lift, and working against channel-iron guides 6 in. by 3 in. by 3 in. by ⅜ in. on the front of the 16 standards. There are 32 rollers attached to the cup of the outer lift, in 16 carriages, 16 of them 6 inches diameter and 4 inches wide, working against the T-iron guides 4 in. by 4 in. by ½ in., fixed on the inner lift, and 16, 12 inches diameter and 3½ inches wide, working against the channel-irons on the front of standards. Sixteen rollers, 9 inches diameter and 3 inches wide, are fixed in chairs on the standards, and run in channel-irons 6 in. by 3 in. by 3 in. by ⅜ in., fixed on the outer lift; all as shown on the diagram given in the "JOURNAL" for Jan. 7 (*ante*, p. 24).

3.—The depths of the channel-iron grooves, in which the rollers run, are 2½ inches. The grooves of the rollers which work against the T-irons are 2 inches.

4.—The *sum* of the "plays" of two rollers diametrically opposite to each other is not more than 1 3/16 in

5.—Play observed each fortnight, when rollers were smeared; and no greater play than 30 mm. (1 3/16 in.) has been observed.

6.—See under No. 2.

7.—There was adjusting when the holder was at the top; but in lower positions observations were made that "play" existed.

8.—The guide-rails were tested for vertical adjustment.

9.—We have noticed that the weight of only one man would tilt the inner lift over to whichever side he went.

10.—No. 12 B.W.G., excepting plates of special thicknesses.

11.—The daily observations were made at 11 a.m.; and the fire took place at 12.30 p.m.

12.—Space between inner and outer lift, 16 inches; breadth of the dip, 8 inches; breadth of the cup, 12 inches; space inquired for, 8 inches.

Inequalities are not noticed.

HJ. SAMZELIUS.

Gothenburg, March 17, 1896.

Additional Capital for the Kingston Gas Company.—The Kingston-upon-Thames Gas Company have resolved to issue the balance of their authorized loan capital, which amounts to £16,000; thus making a total issue of mortgage bonds of £25,000 at 4 per cent. The money is required for the enlargement of the works and the erection of a gas-holder and purifying plant.

Belfast City and District Water Commission.—Mr. R. J. M'Connell, J.P., was re-elected (for the fourth time) Chairman of the above Trust last Tuesday. In thanking his colleagues for this fresh token of respect and honour, he generally reviewed the position of the undertaking. He said that all the works contemplated by their Acts previous to the Mourne scheme had been fully completed; and the new scheme had received considerable attention. During the year, the revenue had increased largely; and the Board had participated in the progress and prosperity of the city. The income for the year showed an advance of upwards of £4000 compared with the preceding year; and this was very satisfactory. While the work was being carried on in connection with the Mourne scheme (which would last some five years yet), they would have no income from the works; and, therefore, the question arose how the interest on the large sum of money they would have to spend could be met without throwing very large responsibilities upon the present ratepayers. The Board took powers under their last Act to accumulate what they might call a reserve fund; and they had been able to save a surplus revenue of something like £36,000. In this way, he hoped they would be able to tide over the years of exceptional expenditure without increasing the rates. During last year, one difficulty had arisen. For the first time in their history, the whole of their property in Belfast and in the counties had been rated for taxation. There was no doubt that, whatever amount they had to pay the Corporation in taxes, if the Commissioners had to increase the rates (which he hoped they would not have to do) the Corporation would have to account to the ratepayers for the money thus taken from them. Mr. J. Laid was afterwards re-elected Deputy-Chairman.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Monday, March 16.

METROPOLITAN COUNTIES WATER BOARD BILL.

Lord JAMES of HEREFORD, in presenting the above-named Bill, which is for the better control and regulation of the water supply to the Metropolis and the surrounding districts, said: The great public interest apparently taken in this question of the supply of water to the Metropolis, renders it desirable that a short explanatory statement should be made of the nature and the provisions of the Bill now presented to the House on the subject. Her Majesty's Government have framed the Bill upon the assumption that there exists a great and a growing opinion that the time has come when the management of the water supply of the Metropolis and the surrounding districts should be vested in the hands of a responsible and a public representative body. This assumption is not founded on the view that the Water Companies have neglected their duties to the consumer; but at the same time it is somewhat anomalous that interests so vast should be placed in the hands of trading Companies who must have duties cast on them of considering their shareholders as well as the interests of the consumers. This view, of giving the management of the water supply to a public body, has received a great deal of parliamentary sanction. Thirty years have now nearly passed since the Commission presided over by the Duke of Richmond recommended that this body should be created, and the powers vested in that body. In 1880, Sir William Harcourt's Commission made the same report to the other House; and there were similar reports from different Committees. Under these circumstances, I hope there will be a concurrence of opinion that this public body has to be created; and I shall assume a like agreement that the body must be a municipal body. I do not think that anyone would suggest that it should be the duty of the Imperial Government to take the charge and control of such a matter as the water supply of a community, however important it may be; and assuming this right in the municipal body, I presume it will be agreed that this municipal and representative body should take charge of the water consumers' interests. In the first place, we naturally look to see whether there is a body in existence ready at hand to take charge of these great interests. Very often, we find that the power of controlling the water supply passes into the hands of the large municipal authorities; but in the case of London, we find that the only body in whom such power could be vested would be the County Council. In determining whether we could invest the London County Council alone with these great powers, we have to ask over whom these powers would have to be exercised. The water supply of London now proceeds from eight different trading Companies, who supply not only Central London, which is under the control of the London County Council, but that outside area over which the London County Council have no jurisdiction—an area which we may term "Water London." It is a very extensive area—extending into different counties—throughout Middlesex into Surrey, Kent, and Hertford, from the borough of Croydon to that of West Ham. It stretches from the centre of London to Romford in Essex; as far as Esher in Surrey; as far as Ware in Hertfordshire; and in Kent as far as Chevening. This area includes some 620 square miles. The area over which the London County Council have jurisdiction within Water London includes 121 square miles. Therefore I am sure that it will be brought home to your Lordships' minds that there are large areas outside of the jurisdiction of the London County Council with which we have to deal. It is difficult to suppose that these outside areas would be content to be governed and rated, as far as regards their water supply, by the London County Council, upon which they have no representation. We have therefore come to the conclusion that we cannot accept the London County Council as the body to control the water supply of the area outside their jurisdiction; and we have determined to create a new representative body, which shall be elected by all the various areas affected in certain proportions. Having come to this conclusion, the question arises, How shall that body be formed? The first point to be determined is as to the numbers of the new body; and we have thought that, upon the whole, 30 will be the best number to fix upon, which would enable a fairly representative body to be constituted—not too large to relieve the individual members of their responsibility, while it would enable the duties imposed upon them to be properly discharged. Then comes the question, By whom shall the members of the body be elected? I have said that we cannot place these powers in the hands of the London County Council alone; but we cannot, of course, take exception to the view that the London County Council are entitled to the very greatest consideration when we are forming this new body. In introducing permanent legislation of this character, we must look not only to the present but to the future population of the whole of the area that will be affected, and also to the property that is comprised within the area, as shown by its rateable value. The population of what we term Water London is about 5½ millions—the numbers are only approximate, because I am taking those shown by the census of 1891—while that of the area under the control of the London County Council is 4,232,000. The rateable value of Water London is £41,745,000; while that of the London County Council area is £30,000,000—making the rateable value of the outside area £11,745,000. Of course, these figures show that the London County Council have a predominant claim to representation on the new body. In order to estimate the growth of the population of Greater London in the future, we must see what has been its growth in the past. In 1841, the population was 2½ millions; and in 1891, it had increased to 5½ millions. In the report that was presented by Lord Balfour of Burleigh's Commission in 1893, it was estimated that in 35 years hence—that is to say, in 1931—the population will have increased to 11 millions, or more than double its present number. In shaping this legislation, therefore, we must provide a mode of representation that will satisfy the future rather than the present population of Greater London. In this view, then, we must look to where the great increase in the population is likely to take place throughout the whole area to be affected. No doubt, the great

ncrease in the population will take place outside of the area under the jurisdiction of the London County Council, which is at the present time densely populated. There will be a growing tendency in the future for working men to avail themselves of railway facilities, and live in the suburban rather than in the urban districts; and this circumstance will cause a greater proportional increase in the population of the outer areas as compared with that of the population of the central area. We may be told that we ought to wait until that proportional increase in the outer districts has taken place, before we provide for its representation on the new body. In our opinion, however, that would not be the just course to take; and the body that we propose to create will be formed in view of the future growth of the population. We, however, have treated the London County Council as having a predominant interest in the new body; and we have accordingly taken care that they shall have a majority on the Board. I have mentioned that there are to be 30 members on the new Board; and of these 28 seats will be ascribed to the different areas representative of the consumers. Of these 28 seats, we propose to give 16 to the London County Council, which will give them a majority on the Board. We give to the Corporation of London—which is a body separate from the London County Council, for all water purposes such as exist at the present time—two seats. We propose to give the County Councils of Middlesex, Essex, and West Ham, two seats each; and to the County Councils of Surrey, Kent, Hertford, and Croydon, one seat each. This leaves only two seats undisposed of. Of these two, we propose to assign one to the Thames Conservancy, which requires to be represented upon the new Board as being a body representing a great interest, inasmuch as your Lordships are aware that the greater proportion of the water supply of the Metropolis is obtained from the Thames. The remaining seat we propose to allocate to the Lea Conservators, though perhaps their claim to representation upon the new body is scarcely as strong as that of the Thames Conservators. Then the great question arises as to whether the representation upon the new body should be direct or indirect. Direct representation, of course, would mean an appeal to the ratepayers in all these areas to elect a certain number of representatives. In the first place, we came to the conclusion that the inhabitants of the Metropolis were under the feeling that they have had quite enough of local elections for the present; and we also felt that there would be more difficulty in selecting by the ratepayers the proper persons from all portions of the districts as members of this body. We may have a vast number of candidates nominated; we may have contested elections; and yet you may not always obtain the election of the best and truest representatives of business interests. In these circumstances, we have felt that the County Councils can be trusted to select the members to be placed on the Trust. In former times, it was objected that the old Metropolitan Board could not make such a selection, because it was not a popularly elected body. That cannot be said, I think, of the London County Council. The election of the Council is a popular election, so as to make the indirect representation upon this Water Trust sufficiently in touch with the ratepayers to justify the selection of the members of the Trust by the Council. We have felt that it is not necessary that the selected members of the Water Trust should be members of the respective County Councils. We have heard it said that the members of the London County Council have great and important duties cast upon them; and, however meritorious their efforts to discharge them may be, they press heavily upon them. It may be, in these circumstances, that the County Councils may wish to select from outside their own bodies some persons of great knowledge and experience in these matters; and therefore we have not limited the members of the Water Trust to members of the County Councils. One other great question remains. Having formed your body under this Bill, what are the duties and powers you are going to vest in it? I know there are many who have anticipated that the Bill will solve every difficulty. We have made every attempt to see how far the Bill could solve the difficulties that have arisen; and it has been found impossible by a public Bill to bring all these matters to a solution. When what we have to deal with is considered, it will be recognized that this cannot possibly determine every matter, and solve every question, that has arisen. The interests of the Water Companies must be acquired in some way. The Companies must receive compensation; the terms under which the transfer of their interest is to take place must be arranged; and I say, with great deference, that these are matters which cannot be dealt with by a Public Bill, but will have to be dealt with by subsequent private legislation. This body being created, we have endeavoured to give it very wide power; and we shall trust to its judgment and discretion entirely. It will be for the body, as soon as it comes into existence, to meet and deliberate, and do what it can to acquire the great interests the care of which will be placed in its hands. Of course, it must do this subject to the sanction of Parliament. We cannot give it compulsory or rating powers until the powers it seeks are known. When the new body says, "Give us this power or that," it will be for those who are interested in relation to the exercise of those powers to be heard also; and for Parliament then to give its final judgment. With this object in view, we give to the body the power to enter on any negotiations, make any agreement they can, and take over the interests of the Companies by adoption; and we have purposely left this discretion and power in as general terms as possible, in order that the new body may be unfettered in its action. As a preliminary matter, we place in their hands all the existing powers of control over the Water Companies now in the hands of the London County Council under the Metropolitan Acts, and which may be usefully exercised until the property passes into their own hands. We are aware that when we propose that this body should come into existence, we shall have some objection made to it, probably, by the representatives of outside areas. They may say, in their criticism, "You are joining us too closely with Central London. We represent rural districts. Let us manage our own water. Let us be free to make our own arrangements. We do not want to go far afield to supply our rural districts." There may be great force in all this; but we cannot leave them out at present. We cannot dissect the water supply, and say that one county shall take so much, and another county so much. That must be a matter for arrangement and the approval of Parliament. Therefore we have put in the Bill a clause which will enable the outside districts to make arrangements for autonomous rights, and so to fall out of the Trust. The clause is inserted in the hope that it may facilitate these bodies maintaining their freedom of action. I believe I have now mentioned the principal provisions contained in the Bill. There are other provisions in the Bill for the purpose of facilitating its action; but I do not think it is incumbent on me to further detain your Lordships upon them. In conclusion, I would only say that the Government have had but one object in view. They have been aware of the numerous interests actively called into action in relation to this matter of the water supply; and they are fully cognizant of the many contentions that have taken place in past years in relation to these interests. The view of the Government has been that the time has come for these contentions to be brought to an end; and their wish has been to act as arbitrators, as it were, between the different interests. Having this object in view, in now presenting the Bill to the House, they ask from your Lordships not only that impartial consideration which I know it will receive, but your assistance; and I can assure your Lordships that if any suggestions should be made that will tend to the improvement of the Bill, and make it a more workable and useful measure, the Government will not turn a deaf ear to them from whatever quarter of the House they may come.

Lord TWEEDMOUTH said he would venture to suggest to the noble Lord that the title of the Bill should be "A Bill to Exclude the London County Council from the Power of Dealing with the Water Question." The provisions for setting up the proposed new body ran counter to every precedent. All other great cities—such as Glasgow, Liverpool, Manchester, and Cardiff—had dealt with the water question through their Corporations; and they had overcome all difficulties. He contended that the creation of the new body was opposed to the wishes of the various bodies which were being included within the Trust, and also to the reports of Parliamentary Committees. He should like to hear from the noble Lord what local authorities he had consulted, and from which of them he obtained consent to his proposal. So far as he (Lord Tweedmouth) could judge, none of them wished to come within the Trust at all. At a conference which took place between the London County Council and the Corporation of the City in 1891, it was agreed that the Water Committee then suggested should be composed to the extent of seven-eighths of representatives to be appointed by the Council and of one-eighth of the representatives of the Corporation. In the same year, a conference took place between the Council and twenty members of the various outside authorities; and a resolution was arrived at to the effect that the system of water management and distribution as generally adopted in provincial towns would be preferable to the establishment of a Water Trust, and that the supply of water to each district in the Metropolitan area outside the County of London should be, as far as practicable, in the hands of the local authority, and that in the County of London it should be placed in the hands of the London County Council. The reports of two Committees of the House of Commons had proved that, in the opinion of these Committees, it was desirable that the Council should be the Water Authority for London. He placed an entirely different interpretation upon the report of Sir W. Harcourt's Committee to that which had been put upon it by the noble Lord. The Committee reported that, in the absence of any single municipal body to which powers of water supply could be entrusted, a water body of a representative character should be constituted. He maintained that this distinctly pointed to the opinion of the Committee that, if there were such a municipal body, it should be constituted the Water Authority. In 1888, the London County Council was created, and that body was recognized as the municipal authority for London by a subsequent Committee over which the present Home Secretary presided in 1891. The Committee stated in their report that, if the London County Council should so resolve, it should have the power to promote Bills in Parliament for the purpose of constituting itself the responsible Water Authority of London, or in conjunction with the Corporation of London through a Statutory Committee. He maintained that the instances he had given showed that it was certainly within the mind of Parliament, and of important Committees appointed by the House of Commons, that the London County Council should be the Water Authority for London. In the Council itself, the question had often been mooted—in fact, it was the water question which had much to do with the original constitution of that body. The subject had always been dealt with with the utmost moderation, and with an absence of party feeling. It had been felt that a commodity such as water should not be made a subject of profit by a trading company, but should be in the hands of a public body. The policy of the London County Council had been, first, that the Council should not be passed over; secondly, that the outside areas should be dissevered for water purposes, and that the various places should provide themselves with water. This was the view taken by the outside authorities themselves, as was shown by the petitions presented in 1891 and 1895 by Kent, Middlesex, West Ham, and Hertford, praying that they themselves might have the control of the water within their own areas The third principle insisted upon by the Council was that the Water Companies' businesses should be acquired at a fair and reasonable rate. The Council had introduced Bills which were now before Parliament upon this subject. Its Chairman, by the unanimous vote of the whole Council, had lately entered into negotiations with the Companies. These negotiations had proceeded in the most satisfactory manner, and in the case of four of the Companies had almost met with success. The effect of introducing the new body would be to break off all the negotiations—at any rate, to transfer to the new body the very things which the Council had been doing, and which it had the authority of Parliament for doing. As he understood it, the immediate power that was to be given to the new body was to apply to Parliament in order to promote legislation. What was the opinion of the Water Committee of 1891 on this subject? The Chairman of the Committee stated that, after considering the matter very carefully, they were of opinion that no Bill would be satisfactory which merely constituted a public authority to promote Bills in Parliament. Yet the Government of which the Chairman of the Committee was Home Secretary took a course in entire opposition to the doctrine laid down by Sir Matthew White Ridley in Committee. The noble Lord had laid great stress upon the large area outside the County of London which was supplied with water by

the Companies. He said there were 620 square miles supplied by them, of which only 120 miles were within the district of the County Council. It must be remembered, however, that though the Water Companies might have powers of supply to the whole 500 miles, it was only to a comparatively small portion of the district that they actually supplied water at present. He did not think, therefore, that the argument of great area was a very strong one; indeed, if the area outside was so very great, it would be an additional reason for the outside authorities undertaking the supply of water within these areas. He found that for four-fifths of the population the noble Lord gave a bare majority of representation on the new Board. This did not seem to him to be dealing very fairly with the matter; for surely four-fifths of the population were entitled to have a majority of more than a single person on the Board. The noble Lord asked what they would do when London had grown, and there was a population of 11,000,000 within Water London? He should say that London would do exactly the same as Glasgow and other large towns had done. It would extend its area, and the County Council would increase its number of members and the area from which it would receive representation. This appeared to him to be a much simpler plan than that proposed by the Government. It seemed to him a pity that the Government should have stepped in to interfere with the good work done by the County Council. If they had been going to deal with the matter, they might fairly have made the new body a Statutory Committee of the Council. He desired to enter an emphatic protest against the proposal in the Bill to constitute a new authority for dealing with the water supply of London.

Viscount KNUTSFORD said that for twenty years he had taken a very active part in the management of one of the London Water Companies. He thought, therefore, he could claim to be thoroughly conversant with the subject to which the Bill referred. On the part of the Companies, he was grateful to the Government—and he believed he spoke the general feeling of the Companies—for having stepped in and put an end to the designs of the London County Council. In the first place, he thought it was important that there should be a Board on which all interests could be fairly represented—the interests of the counties from which the water was drawn, of the County Councils, of the Thames Conservancy, of the City, and of the Water Companies. This seemed to him a most important element in the case; and that representation could never be fairly obtained on the County Council. He would not at present enter into a discussion of the details of the Bill. The proper time to do that would be when the measure had been printed, and when the second reading was moved. As to the position of the eight Water Companies affected by the Bill, he observed with pleasure that the noble Lord who introduced it said it was not brought forward because of the failure of the Companies to perform their duty to the consumers. He would go farther than this, and say that the Companies were confident and satisfied that they had performed their duties thoroughly and loyally to the consumers. He was aware that a great many persons dissented from this view; but he had always found that those who dissented were persons who had not studied the great mass of evidence brought before the Royal Commissions and Select Committees. What the Companies relied upon in the first place was the evidence given before these Commissions and Committees. They also relied on the annual reports of the Local Government Board, and especially on the recent reports, because great improvements had been made during the last fifteen years, both in the method of filtration and the storage of water. They relied on the reports of the Official Water Examiner to the Local Government Board—Major-General Scott—who had devoted great attention to the subject. He (Viscount Knutsford) thought he would not be wrong in saying that, if this gentleman were examined, he would say that the Companies had readily and to the best of their ability met all the suggestions he had made from time to time for improving the water supply. They also relied on the monthly reports presented to the Local Government Board by eminent analysts. Dr. E. Frankland had perhaps more than any man in the country devoted his time to the study and close examination of the water of the Thames, as it was taken out, and as it was delivered to consumers after filtration and storage. They further relied on the reports of Professors Crookes and Dewar, who took samples every day of the water from any part of the service of each Company. In addition to all these authorities, the Companies relied on the report of the Royal Commission presided over by Lord Balfour of Burleigh. He maintained that the position of the London consumers supplied by any of the eight Companies compared most favourably with the position of those in the other large towns of the country—like Liverpool, Manchester, Hull, Birmingham, and Bristol. The quality of the Thames water, moreover, was approved, as long ago as 1869, by a Royal Commission, presided over by the Duke of Richmond. The inquiry by this Commission was so exhaustive that it had formed the starting-point of all subsequent investigations and inquiries; and since that time the quality of the water had been upheld by the analysts. As to its purity and wholesomeness, he (Viscount Knutsford) would cite the report made by Lord Balfour's Commission, which was composed almost entirely of experts. Lord Balfour was the Chairman; and the other members were Sir G. Bruce, Sir A. Geikie, Professor Dewar, Messrs. Hill and Mansergh, and Dr. W. Odling. The inquiry held was most exhaustive; and in their report, the Commissioners stated: "We are strongly of opinion that the water as supplied to the consumers in London is of a very high standard of excellence and purity, and it is suitable for all household purposes." If, therefore, the price and the quality of the water were established, their Lordships would not be surprised to hear that the Companies would prefer to keep the management in their own hands. If, however, it was the opinion of Parliament that the time had arrived for the management to be vested in other hands, then the Companies submitted that compensation should be paid on fair equitable principles, such as had been ratified and established by Parliament in the Lands Clauses Consolidation Act and other Acts dealing with compulsory purchase. The Companies claimed this as a right from Parliament. A large body of their shareholders were trustees, and many poor people who had invested their savings in the undertakings of the Companies depended on the dividends for their livelihood. Though he did not put this consideration forward as a reason for giving more compensation than was reasonable, he did put it forward as a claim for compensation on equitable principles. He entered a strong protest on the part of the Companies against the unrighteous proposals for compensation suggested by the County Council. He thought his noble friend (Lord Tweedmouth) was wrong as to the negotiations of the Council with the Chairmen of the Companies. No proposition had been made which the Companies could possibly accept. Every proposition that had been made fell short of any compensation which had been given in the case of compulsory purchase in other cases. A Water Board, where all parties and all interests could be properly represented, was the proper authority to undertake the management of this great business. The County Council had already sufficient work to discharge; and he did not think they appreciated the close attention and responsibility needed in the management and supply of water to consumers within so enormous an area as the one affected.

The Earl of WEMYSS thought his noble friend had begged the question; he had simply indulged in vague prospective possibilities as to a deficiency in the supply of water when the population had increased to a certain figure. As to the quality of the water, he (Lord Wemyss) was supplied by the Grand Junction Company; and he only wished he had as good a supply in Scotland. It was much softer, and not so full of chalk and lime. The Commission reported that the water was of very high quality for domestic purposes; and it appeared from the evidence of medical officers that they could not trace a single case of illness to deleterious particles or to organic matter in the water supplied by the London Companies. There was scarcely a town in the country of which as much as this could be said. As to the prospective increase of the population, the Commission reported that, from existing and from readily available sources, water sufficient to supply consumers at the rate of 35 gallons a head could be obtained, and be easily available for 12,000,000 people.

Lord MONKSWELL said the local bodies outside the London area would look with much disfavour upon any interference with the control of their water supply. The noble and learned Lord who introduced the Bill proposed to get over this difficulty by stating that, under certain circumstances, these authorities might contract themselves out of the Water Trust; but he was perfectly certain that this proposal would not commend itself to their approval. They would say that the Water Trust was an engine of oppression, and would consider they would be worse off under the Bill than if they were placed in an autonomous position.

The Bill was then read the first time. [The principal portions of the Bill will be found on p. 651.]

The following progress was made with Bills last week:—

Bills reported: Birmingham Corporation Water Bill, British Gaslight Company Bill, Cheltenham Gas Bill, Cowes Gas Bill, Falkirk and District Water Bill.

Opposition withdrawn: Cheltenham Gas Bill, Falkirk and District Water Bill, Redheugh Bridge Bill.

A petition was presented against the East Surrey Water Bill.

HOUSE OF COMMONS.

The following progress was made with Bills last week:—

Bill read a second time and committed: Ilfracombe Gas Bill.

Bills reported: Brighton Corporation Water Bill, Dewsbury and Heckmondwike Water Bill, Whittington Gas Bill (preamble not proved).

A petition was presented in favour of the Ilfracombe Gas Bill, and one against the Fylde Water Bill.

HOUSE OF LORDS COMMITTEE.

Monday, March 16.

(*Before Lord* POLTIMORE, *Chairman; the Earl of* STAMFORD, *Lord* STANMORE; *and Lord* KINNAIRD.)

BRITISH GASLIGHT COMPANY (NORWICH) BILL.

This Bill, which is to empower the British Gaslight Company to extend their works, and expend further capital upon their Norwich station, came before the Select Committee to-day.

Mr. BALFOUR BROWNE, Q.C., Mr. WORSLEY TAYLOR, Q.C., Mr. T. BAGGALLAY, and Mr. LEONARD LUKES represented the promoters. The Bill was opposed by the Corporation of Norwich, for whom Mr. POPE, Q.C., Mr. FREEMAN, Q.C., and Mr. E. WILD appeared.

Mr. BALFOUR BROWNE, in opening the case for the promoters, said the Bill was exceedingly simple; and there was only one matter of a little complication which required some explanation. The British Gaslight Company was formed, under a deed of settlement, in the year 1824. The head office was in London; and they had stations for the supply of gas at various points in England. In this respect, the Company was different from ordinary gas companies. Usually, a company was started to sell gas to an individual town or district; but in this case, the Company was formed for the purpose of supplying gas everywhere where it was wanted, and stations were established at Norwich, Hull, Hanley, Trowbridge, and Holywell. The Company had, therefore, five distinct stations, where gas was supplied and manufactured; and though every one of the stations was carried on under various Acts of Parliament, the Company itself was still a limited concern under General Acts. In an ordinary case, a company could not raise more capital than Parliament allowed; but in this particular instance, the British Gaslight Company, being a limited company, could raise just as much capital as the shareholders chose to allow. It was not limited in any way by the Act of Parliament; and, at the present time, the share capital amounted to £420,000, in 21,000 £20 shares. It was because of this complication of a limited company and separate stations, that fuller explanation was necessary than in an

ordinary gas case. Each of the different stations was conducted under separate Acts of Parliament. Norwich, from 1825 to 1858, was lighted by what was called the Norwich Gaslight Company. All the shares in this concern were held by the British Gaslight Company. In the year 1858, the British Gaslight Company applied to Parliament for an Act which dissolved the old Norwich Company, and empowered the British Gaslight Company to manufacture and supply gas in Norwich. This Act of 1858 incorporated the Gas-Works Clauses Act, 1847; so that their Lordships would see that the consumers of gas in Norwich had the full protection of the General Act which limited the amount that could be divided in profit, as well as the amount that could be charged for gas. There were various other provisions in the General Act, which were made applicable by the incorporation of Norwich in the year 1858. Section 16 of the Act of 1858 recited that £68,326 had been spent on the works; and it authorized the Company to expend further capital. All through these Acts, the British Gaslight Company were not authorized to raise, or issue capital, but merely to expend it upon the particular stations; and this was the distinction which Parliament drew between this Company and other companies. There was a section which provided that the accounts of the Norwich undertaking should be kept separate from those of the Company's other undertakings, and that a copy of the accounts should be sent to the municipal authority, by whom an auditor was appointed; the contribution to be paid by the Norwich station of the Company being fixed by the Act. Practically the only connection between the Norwich station and the head office was the payment of £600 a year for the Directors and office expenses in London. By a subsequent Act, this £600 was increased to £1000. Under section 25 of the same Act, the price of gas was to be 4s. 6d. per 1000 cubic feet in Norwich, and 5s. 6d. in certain outside districts. It was provided at that time that the quality of the gas should not fall below 11 candles. The illuminating power of gas varied at different parts of England, owing to the vicinity of the gas-works to cannel coal. In Glasgow, it was 24-candle power; but in the South of England, 14 candles was about the rule. In this particular case, however, it had been limited to 11 candles. By section 30, there was to be a testing-place established, where the illuminating power could be ascertained and tested; and the Company were to be under a penalty if they did not supply gas up to the quality required by the Act. All these provisions were made by the Act of 1858. Between 1858 and 1875, the Company had expended on the works at Norwich all the capital that had been authorized; and therefore they had to come to Parliament again. They did so, saying that the amount of capital authorized (£100,000) had been expended, and asking leave to spend a large additional sum. They wished to lay out at that time, and in succeeding years, £100,000 more; and the illuminating power was to be raised from 11 to 14 candles. There was also a clause put in the Bill which was not very common, to the effect, that the Company were not to allow more than 30 grains of sulphur or 5 grains of ammonia to be present in 100 feet of gas sent out from the works. The same thing had happened between 1875 and 1895 which took place between 1858 and 1875. The Company had gone on supplying gas—doing their duty by the public admirably; but as time had proceeded, they had spent the whole of the authorized capital. To show the increase in the demand for gas, he pointed out that in 1876 there were 19,626 buildings such as might take a separate supply in the Company's district; and in 1891, there were 32,866. The population, which was 83,000 in 1875, was 101,000 in 1891; and in 1895, it was estimated at 107,000. The consumption of gas in 1876 was 224 million cubic feet per annum; whereas in 1895 it was 289 million feet. They had introduced a thing which was eagerly run after—namely, the penny-in-the-slot meter. This had largely increased the consumption of gas; and in 1895 no fewer than 2362 slot meters were in use in Norwich. Curiously enough, the number of private consumers had not increased; but this was accounted for by the fact that the boot and shoe trade had concentrated itself from small individuals into large factories. The Company were now at the end of their tether in Norwich, having spent their £200,000, and £5000 or £6000 beyond it; and they asked power to raise another £100,000. The immediate expenditure on new mains and other things would amount to £64,000; and the increased amount to be laid out on distribution would be £2725 per annum. They calculated that they would not require to return to Parliament for another fifteen years—the usual time that gas companies were allowed to remain away. The Company had bought land which, when the Bill passed, would be used for the manufacture of gas. The capital of the Norwich undertaking was £6 11s. per ton of coal carbonized—a small average; and a million cubic feet of gas were produced per £600 of capital, which compared very favourably with other undertakings. The new capital would be secured in the cheapest way possible. £60,000 would be raised on stock—a limited amount of profit being taken in respect of the shares of the Norwich undertaking; and £40,000 would be borrowed money. The interest on the shares would be limited to 5 per cent., and that on the borrowed money to 4 per cent. Counsel then dealt with the petition of the Norwich Corporation against the Bill. He said that the 13th paragraph of the petition read: "Your petitioners desire to point out that, owing to the exceptional constitution of the Company, they have hitherto escaped the conditions with respect to the issue of additional capital usually imposed by Parliament upon gas companies." This referred to the auction clauses; but he submitted that it could not apply to a limited company. The only question was whether or not they had supplied the gas satisfactorily. The petitioners said in paragraph 8: "By virtue of the said Acts, the amounts to be paid as profits or interest to the Company in respect of the capital employed in the Norwich undertaking are limited; and when those amounts are paid to the Company, the gas consumers in the district are entitled to a reduction in the price of gas supplied to them." The Company, however, had not filled their reserve fund. The petitioners went on to complain of the quality and price of the gas. But they themselves had the power to appoint an analytical chemist to test the gas; and as to price, it was lower than at Lowestoft, and the same as at Colchester. The petition went on to say: "They most humbly submit that it is inexpedient, having regard to the peculiar and exceptional position of the Company, to extend their powers; and that the Norwich undertaking should rather be transferred to your petitioners, on terms to be settled by arbitration, if not otherwise agreed." If the petitioners desired to acquire the undertaking, they should have promoted a Bill for the purpose; but it was doubtful whether Parliament would have given the power, seeing that the Company supplied gas outside Norwich itself, and that for the Corporation to serve the outside district would render them a commercial company themseves. Having criticized the remaining paragraphs of the petition, the learned Counsel proceeded to call evidence.

Mr. *Frederick Lane Linging*, Secretary of the British Gas Company, Limited, examined by Mr. WORSLEY TAYLOR, corroborated the statement of Mr. Balfour Browne as to the constitution, financial position, and operations of the Company. He stated that each of the five stations was conducted separately; having its own accounts, books, and so forth, and separate Acts of Parliament. Every right which the Company had, and every advantage which the public possessed under the Gas-Works Clauses Act, was incorporated in the Acts under which the Norwich undertaking was carried on. The whole of the capital authorized had been expended; and unless further powers for raising money were given, the Company would be unable to supply their customers, and the city of Norwich would be in darkness. Their public lighting rental had never produced a profit; and they were supplying gas for public purposes at 2s. 4½d. per 1000 cubic feet, which was cost price. He considered that they had been dealing very generously with the city; and, as a matter of fact, they had given satisfaction to the public. He pointed out that, in order not to incommode the town, the material for the manufacture of gas residuals was taken from Norwich to Yarmouth—a distance of 32 miles; the cost being £500 a year. This expense had not to be met in the case of the Hull station; and the coals could be obtained there at 10s. 1d. per ton, as compared with 15s. at Norwich. Still, the Company did not favour Hull in any way as against Norwich. Why should they? No company, with one exception, supplied gas as cheaply as they did in the whole of England. They did as well for Norwich as they did for Hull, and used the same economy in the one case as in the other. But circumstances were not so favourable at Norwich as at other stations. With regard to the penny-in-the-slot system, it had been largely taken up in the poorer districts, and was developing. A mechanic found it difficult to pay a sum of 6s. or 7s. a quarter for gas; but when he was able to get his gas in pennyworths, he did not feel the cost. It was a great convenience to him to have gas, say, at breakfast time in the winter. The Company, in the case of Norwich, had no reserve fund; they could not even make up the profit they were entitled to take. At the end of the last half year—June, 1895—they were £1700 short. As to price and purity of their gas, the Company were well within the standards laid down by Parliament. This was not the first time the suggestion as to the auction clauses had been made. In 1857, the Company had applied to Parliament for an Act covering the whole of their stations; but Lord Redesdale said that Parliament could not give them the power, and told them to make application in respect of each station. In 1858, they approached Parliament in respect of three stations—Hull, the Potteries, and Norwich. In that year powers were granted to them, under which they had been acting up to the present time. The question as to the auction clauses was mooted; but the Company had not power to raise money for each separate station. They could only spend capital; and the power they were now seeking was similar to that they asked for in 1858—namely, to expend certain capital. Similar powers had been conferred on them twice. There was no ground for the complaint as to the manner in which the Company carried on their Norwich business, and no reason why power should be given to the Corporation to compulsorily acquire the works. Power of this kind had been refused by Parliament in the case of Hanley.

Cross-examined by Mr. FREEMAN, witness said that any complaint as to the management of the Norwich works had to be sent on to London, to be considered by the Board. The dividends the Company usually paid were 10 per cent., with a bonus of 2s. 6d.; representing altogether 11¼ per cent.

Mr. FREEMAN: Do your shares command a very high premium?

Witness: Yes; all gas properties do.

Never mind other properties; take your own. You get a considerable premium on all the shares you raise, do you not?—Yes; we have had as much as £20 and £25.

What are they quoted at now?—£54 or £55.

That is to say, every £20 share is quoted at £55?—Yes.

You have no reserve fund?—No.

Have you never had one?—Oh; yes. We have had as much as £6500.

You have never been in a position to get it full?—No, we have not.

What would fill it at Norwich?—Ten per cent. on the nominal capital employed there—say, £20,000.

So that until you are paying your full dividends, and your reserve fund amounts to £20,000 (or £30,000, if this Bill passes), the public can claim no reduction in the price of gas?—I do not accept that. We have reduced the price on two or three occasions when our reserve fund was very low indeed.

But that was your voluntary act. Until you are paying your full dividends, and have a full reserve fund, the consumer will have no right to demand a reduction in the price of gas?—No.

Is the consumption of gas at Norwich increasing?—Yes.

The tables you have put in, taken from 1876 to 1895, show that there were great fluctuations in the sale of gas; and that, so far as we can see, in 1894 there had only been an increase over 1876 of 50 million cubic feet?—Yes. That arose from the poverty of the district. A large part of the population have to depend upon the aristocracy and land owners. Farming in the country has of late been in a terrible state; and the population of the city, including the tradespeople, have greatly suffered. Besides this, we have had to contend against the Electric Light Company, who have taken away a certain portion of our rental from us.

Do you suggest that Norwich has been suffering from depression of trade?—That is what I am told.

This is one disadvantage of having a London Company managing a gas undertaking at Norwich?—But I have local knowledge.

Do not the people complain that your gas is so bad in quality, and

so impure, that they cannot use it?—If they do, it is singular, for the Corporation have the power of analyzing the gas; and we have no control over their Analyst (Mr. Sutton).

Have there not been innumerable complaints from the people of Norwich as to the quality of your gas?—They have never been made to me as Chief Officer.

Do you know that in many small houses the people have taken to use lamps, because the gas is so bad?—I do not know that. It is not fair to compare the conditions of the gas undertaking at Cambridge with those existing at Norwich; the railway rates for coal at the former place being lower than at the latter.

Is it not a fact that you cannot reduce the price of gas to the people of Norwich for the reason that you have to pay dividends upon such a large capital?—No. Our price compares favourably with those of other towns.

Lord STANMORE: What are the reasons which, in your opinion, render the introduction of the ordinary auction clauses impossible.

Witness: We cannot work them. To meet the loss consequent on not being authorized to sell the shares by auction, the Directors, when they have come to Parliament, have always been prepared to take a less rate of interest than they would have got under ordinary circumstances.

Mr. BALFOUR BROWNE: Answer his Lordship's question. Why do you not adopt the auction clauses?

Witness: We are unable to do so, for the reason that we are not allowed to raise money at our stations, but simply to invest it; the money coming from the parent Company. If Parliament had granted the Company a General Act for the whole of their stations, then the capital could have been put up to auction; but Parliament thought it right not to give the Company a roving commission. They compelled us to become a limited liability concern, and to come to Parliament for power to invest money.

Lord POLTIMORE: Do you see any reason why that should not be altered now?

Witness: It would cause a great deal of expense and trouble. We have worked exceedingly well up to the present time.

Mr. BALFOUR BROWNE (to the Committee): I think I can tell you why that should not be.

Mr. *F. E. Linging*, the Manager of the Norwich station since 1876, examined by Mr. BAGGALLAY, said he resided at the works. It was necessary that further works should be erected there for gas supply. They had land which could be devoted to the purpose; but it belonged to the Company, and not to the Norwich undertaking. As to the quality of the gas, he had never had a single complaint either from their testing officer or from anyone else. The officer tested at his own testing-station, without giving warning, though he might be required to give six hours' notice. The Company also tested; and the results they got were similar to those obtained by Mr. Sutton. The Company had 2300 gas-stoves out at Norwich. They were considered necessary as a means of distributing gas. There was a good business done in prepayment meters; the gas sold under that system fetching from 3s. 9d. to 4s. per 1000 cubic feet. New works were required in connection with the works at Norwich; and £13,000 was required to be spent there almost at once. Furthermore, they estimated that provision should be made for a large increase in the cost of distribution. The coal strikes and labour troubles which had occurred of late years had been against the Company financially; but the undertaking was managed with every regard to economy.

In cross-examination by Mr. FREEMAN, witness said that the sale of gas in 1890 and 1891 had been larger than it was subsequently; but this was owing to severe winters. There had been a slight falling off latterly, through the competition of the Electric Light Company. He certainly thought that the consumption of gas was increasing, and would go on increasing, owing to the introduction of gas-stoves and automatic meters. No serious complaint of the gas supply had ever reached him.

Mr. *Francis Sutton*, Analytical Chemist of Norwich, said that he was employed to test the gas at Norwich for the Corporation. The amount of ammonia in the gas had always been much below the limit; and the purifying power and plant of the Company was of the most modern construction. It was quite sufficient, and very excellent. He remembered that on one or two occasions before 1876, the illuminating quality of the gas had been below 14 candles; there had, however, been nothing to complain of in this respect since that year.

Cross-examined by Mr. POPE: He thought that there should be a higher standard of purity and illuminating power imposed on the Company than that under which they worked. Their statutory obligations had been complied with; but those statutory obligations were unusually light. He had known an excess of 5 grains or so of sulphur in the Company's gas, but only on one occasion.

Mr. *T. J. Richardson*, Accountant, who said he was appointed by the Norwich Corporation to audit the Company's accounts, next gave evidence as to the manner in which the accounts were kept.

In reply to Mr. POPE, he said that however dissatisfied the Corporation might be with his work, he was appointed under the Company's Act, and could not be removed as long as he did his duty under that Act. It was not the fact that he audited the accounts of the Norwich branch seven days before the statutory meeting of the Company. He did the work weeks before that; and it took him about four days.

Mr. *Corbet Woodall*, M.Inst.C.E., said he had had considerable experience in connection with gas undertakings in England and abroad. As a Director of the British Gaslight Company, he had acquainted himself with the petition of the Norwich Corporation; and he maintained that increased capital was necessary for carrying on the Norwich gas undertaking. It was also requisite that fresh land should be secured; and he did not think that more money was asked for than was needed. The Company were prepared to raise money on the cheapest terms possible—in fact, he was in a position to suggest that one-third of the amount now required should be raised by debentures at 3½ or 3¾ per cent. If the auction clauses were to apply, the security would be not only on the Norwich undertaking, but also on the Hull and the other stations. So far as he knew, the Company's stock could not possibly be dealt with under the auction clauses; and the Company, failing these clauses, were endeavouring to raise the money in the cheapest way. The interest would not be more than 5 per cent., which was a moderate amount, having regard to the value of gas shares generally. Norwich was not a convenient place for making cheap gas. He thought the Bill was necessary in the interests of the consumers.

Cross-examined by Mr. FREEMAN: Under ordinary circumstances, he was in favour of auction clauses; and if means could be found to apply them to the capital of the Company, he should be glad to see them adopted. He did not say it would be an improvement to the undertaking; but he should like to see the Company on the same footing as other gas companies. The proposal he had made would enable the capital to be raised at a rate at least as low as it would be under the auction clauses. He would suggest that £60,000 should be raised on debentures. If the Corporation desired to purchase the undertaking of the Company at Norwich, they should make a proposal to this effect to the Company, and let it be discussed by the Directors. The increase in the supply of gas by the Company, in Norwich had, he believed, been about 30 per cent. since their last application to Parliament. The condition of trade in Norwich had been bad for many years; otherwise this application would have been made before now. The state of things in the city had improved of late, judging by the gas supply.

Re-examined: The Directors had not been approached by the Corporation to sell the Norwich undertaking; and if a Bill for purchase were prepared, they would appear as unwilling sellers.

Mr. *H. E. Jones*, M.Inst.C.E., the Manager of the Commercial Gas Company, stated that he had examined throughout the works of the Company at Norwich, and was of opinion that they were better equipped for making gas than any he knew. He thought the expenditure on the works, in proportion to the amount of gas made, had not been high. The works were not advantageously situated for the manufacture of gas, owing to the cost of obtaining coals and the difficulty in getting rid of residuals. He believed there was reason to expect a large increase in the demand for gas in Norwich through the automatic meters. While in Norwich there were about 60 consumers per mile of main, in Glasgow, where the automatic meter system had been largely adopted, and there were 500 consumers per mile.

Cross-examined: The £100,000 capital the Company asked for power to expend, would be exhausted in about twelve years. It would be preposterous, as long as England was a free country, to ask the Company to put a clause in the Bill to the effect that, if next year the Corporation of Norwich brought forward a Bill for the purchase of the gas undertaking, the Company would not oppose it. He thought that the standard illuminating power of the gas should be 15 candles, with a nominal penalty down to 14½ candles.

Mr. BALFOUR BROWNE said the Company would be willing to agree to a clause to the effect that the illuminating power should be 15 candles, but that there should be no penalty while it was 14½ candles. That was his case.

Alderman *White*, J.P., Chairman of the Gas Committee of the Norwich Corporation, was the first witness called for the petitioners. He said he was personally a boot manufacturer in Norwich, employing about 1000 hands. He had 500 gas-burners on his premises; and paid the Company some £500 a year. The gas was of poor illuminating power; and he considered the price excessive. At his own house, he had a billiard-table with nine burners; and occasionally the light was so bad that he could not use the table. He was by no means alone in his complaint as to the way in which the Company treated the consumers. It was inconvenient that the head authority should be in London; the result being that the Directors were insufficiently informed as to what went on in Norwich. The Corporation had considered the gas question, and had unanimously decided to make application to Parliament for power to acquire the gas undertaking. The Corporation had had the subject before them for the last eighteen years. The price of gas in Norwich compared unfavourably with adjacent towns; the rate at Cambridge and Ipswich being only 2s. 10d., and at Leicester 2s. 6d. per 1000 cubic feet. The prices at adjacent towns were from 20 to 50 per cent. lower than in Norwich. At the Company's station at Hull, the prices were 40 per cent. less. The difference in the cost of coal was 7½d., as between Norwich and other places; while the charge was 1s. 6d. higher. There had been agitation against the Company in regard to the unsatisfactory quality of their gas for fifteen years; and the people of Norwich had always objected to the profits of the gas undertaking going to London, and paying shareholders 10 per cent. on their shares and a large bonus. They considered that the locality from which the profit was earned should have a share in the benefit by a reduction in the price of gas. He complained as to the present method of auditing or investigating the accounts of the Company, as it did not enable the Corporation to obtain exhaustive information as to the Company's dealings with Norwich. He had never seen an official report from the Auditor—only a printed balance-sheet. The auditor's action was altogether perfunctory; and the Corporation wanted to see him prepare a business-like statement. The decrease which had taken place of late years in the amount of gas supplied to the public, was owing to the bad quality of the gas, and the dissatisfaction felt with the Company. The people had had to resort largely to oil-lamps; more of these being used in Norwich than, perhaps, in any other town in the country. The Corporation thought that if new capital were raised by the Company, it should be by way of debentures.

Cross-examined by Mr. BALFOUR BROWNE, witness said he had frequently had occasion to complain of the supply of gas to his own house. He had been a member of the Corporation for twenty years; and over and over again resolutions had been passed by them complaining of the high price and bad quality of the gas, and of the nuisance caused in its manufacture. He had not the minutes of the Corporation meetings with him; but he knew that these complaints had been made from time to time—not to the Corporation, perhaps, because it was felt that it was useless to complain. He did not know that gas was supplied for public purposes in Norwich at cost price; but as a member of the Corporation, he believed that profits were made in Norwich and applied to the undertakings in other towns. He should not say they did more than they were entitled to do under the Act of Parliament. He used oil-lamps for lighting in his house

generally, and would be glad to use them for his billiard-table too if he could.

Tuesday, March 17.

Mr. *G. M. Chamberlin*, J.P., draper, of Norwich, said he had occasion to find fault with the gas supplied to him on account of its low illuminating power and impurity. In 1892, he had paid the Company £600 for gas; but since then he had largely employed electricity. Before using electricity, he had resorted to oil-lamps, which were very extensively used in the town. The complaints against the Gas Company in Norwich were pretty general; and many resolutions had been passed by the Corporation on the subject. Among others, the Corporation had decided to oppose this Bill, and declared in favour of the acquisition of the gas undertaking by the Corporation. The impurity of the gas was such that the health of his workpeople was injured thereby.

Cross-examined by Mr. BALFOUR BROWNE: He was a shareholder in the Electric Light Company, which was a local concern, and was doing well. The fact that his workpeople had suffered in health through the impurity of the gas had been brought to his notice by the workpeople themselves.

Mr. *Charles Hunt*, M.Inst.C.E., Engineer of the Windsor Street Gas-Works, Birmingham, said he had inquired into the circumstances of the Norwich Gas-Works; and he made himself thoroughly familiar with them. He found that in the eleven years between 1874 and 1884 the increase in the supply of gas by the Company had been 46 million cubic feet, instead of 350 million feet, which was the estimate of the experts. But the capital had increased by about £46,042, or 46 per cent. The dividend charges had increased from 8·8d. per 1000 cubic feet in 1875, to 10·1d. in 1884. The capital of the Company compared very badly with that of other companies per ton of coal carbonized. Taking the Board of Trade returns, he found that the capital was £1 1s. 11d. higher than the average of other companies. The amount was £7 13s. 11d. per ton, which is an excessively high charge. The total outlay on mains and services was £923 per mile, which was an excessive amount. He was decidedly of opinion that the affairs of the undertaking had not been managed as economically as they should have been. The increased consumption of gas had not been commensurate with the outlay; and quite an abnormal amount of money had been applied to dividends. He held that the solution of the difficulty would be to allow the Corporation to acquire the gas-works, which would be much better managed in their hands than they were at present.

In cross-examination by Mr. BALFOUR BROWNE, witness said that although he was what might be described as "a corporation man," he would not say that all gas undertakings should be acquired by corporations where such bodies existed. He had not inspected the Norwich Gas-Works, so that the evidence he gave was merely a statement of opinion. He had made application to be allowed to visit the works, but it had been refused; and as a consequence he had only been able to inspect them from the outside. In taking an average of the cost of manufacture, as bearing on Norwich, he had included all the large gas-works in the country; but no doubt as regarded them the dead charges, so to speak, would be less than in the case of Norwich.

Lord STANMORE: You make a confident assertion that the affairs of the Company would be much better managed in the hands of the Corporation than they are at present. Is that an opinion founded on knowledge of your own as to the business capacity of the Norwich station officials, or on the general idea that the management of these officials has been bad, and that the Corporation would be sure to improve upon it?

Witness: On the general principle that, as the management has been bad in the past, it must be better under the local authorities.

My point is as to your acquaintance with the business capacity of the Company. Have you any knowledge of that directly?—No.

Mr. *Alfred Colson*, M.Inst.C.E., said he had looked into the cost of gas manufacture, and had made a comparison between the outlay in Norwich and that at provincial works of approximately the same size. He found that the cost at Norwich was higher, to the extent of 3s. 9d. per ton of coal carbonized, than at other places. At Norwich, the residuals department was badly managed. The amount expended on the repair of gas-stoves was exceptionally high; while the rents received were very low. Speaking generally, he considered that there was a great absence of economy on the part of the management of the undertaking.

Cross-examined by Mr. BALFOUR BROWNE: The receipts of suburban companies for coke was 7·71d. per 1000 cubic feet; but he did not know that at Norwich 9d. per 1000 feet was realized. He took the figure to be 6d. and a fraction.

Mr. *Gould*, an Accountant practising at Norwich, said that he had examined the accounts at the Norwich station of the British Gaslight Company, and had found that the amount of premiums on the issue of capital which should be accredited to that station was £54,796, allocating it according to share capital. The Norwich works contributed £1000 a year to the cost of the London office.

In cross-examination, witness admitted that if premiums were received in respect of other business than the manufacture and sale of gas, the premiums paid in respect of shares would have regard to that business as well as gas production.

Mr. POPE then addressed the Committee for the Norwich Corporation. He owned that, speaking as a layman, and not having that faculty for dealing with gas figures and gas management which his learned friend professed, he approached the case with some difficulty. It was a singular one; and he thought that before they passed the Bill, they must carefully weigh all the circumstances. No doubt it was a measure which would benefit the British Gaslight Company; but he thought their Lordships would come to the conclusion that it was one which would operate to the detriment of the consumers of gas in Norwich. The original constitution of the Company was sanctioned by Parliament so long ago as 1858. The limited liability Company which appropriated the whole of the profits from the various stations throughout the country, had been created since; and the peculiarity of the case was that all the precautions and protections which Parliament, since 1858, had carefully devised for the benefit of the consumer, could not be applied in this instance. His learned friend had said that the two clauses which Parliament had devised—namely, the auction clause and the sliding-scale clause—were not applicable to the case of this Company; and he (Mr. Pope) agreed with him. Therefore, it was a case of a company coming and asking for further capital expenditure, which must become chargeable to their revenue upon the consumers of Norwich, without any of those precautions which Parliament had said should be included in any Gas Bill which was brought before it. No Gas Bill was ever now sanctioned, in the case of a company, without the capital powers being brought to the test of the auction clauses, and the management being brought to the test of the sliding-scale. The auction clauses enabled the consumer to say: "I have a guarantee that the capital will only be raised at the price which the market will confer on it. There shall be no premiums; or if a premium is realized by reason of the property of the company, the amount of it shall be taken as free, non-profit-bearing, capital." In the case of this Company, £54,000 had been realized by premiums on the issue of capital from the Norwich station. If Norwich had had its share of this—which it must have had under the auction clauses—it would have had £54,000 of free capital. That was to say, the amount of capital burdening the consumer with the necessity of providing a charge for interest would be the difference between whatever had been appropriated in Norwich as premium and the £54,000 to which it was entitled. A Committee dealing with a Bill the like of which would never have been presented to Parliament but for the legislation of 1858, should examine the facts with great care, to see whether or not the requirements of the Company justified them in granting further powers. If this was a case in which the promoters could show that there was a likelihood of the supply of gas running short, or that in the interests of the consumers an increase of expenditure was necessary to some extent, to enable the Company to comply with their requirements, then the petitioners would have said: "Give them the money they require; but surround it with such restrictions as will protect the consumer against mismanagement or undue charge on the capital." But the Company asked for leave to expend a further sum of £100,000; and they proposed that the capital should be raised at, or that in its application it should be liable only to, 5 per cent. interest on the ordinary stock, and 4 per cent. for the debentures. They wanted liberty to charge the Norwich consumer with £100,000—part at 5 per cent., and the remainder at 4 per cent. They sought to burden the consumer of Norwich with interest on this sum, whatever it might be. What did they want the £100,000 for? He had never heard of a Company coming, in the ordinary course, to ask leave to raise capital, without telling the Committee what works they were going to employ the money on, and what the necessity for it was. If in Norwich they were approaching gas starvation, he would give the Company the money; but where was the evidence in this case that there was any necessity to be dealt with? Was there any evidence whatever, even from the Company's Manager, that their works were incapable of producing more gas than was required? No doubt, they had spent the £100,000 they last obtained power to borrow; for it was to their interest to spend it, and to make the capital account at Norwich as large as possible, because they drew 5 per cent. and 4 per cent. from it for the general interest of the Company. Formerly they came for more capital because the consumption of gas was increasing; but their anticipations in regard to the increase had not been fulfilled. The capital they last obtained was sufficient to enable them to make 250 million cubic feet more gas; but if the actual increase had only been 46 million feet, it was clear that the money had not been economically expended—that with greater economy it might have been made capable of producing 200 million cubic feet more. If money was not required as suggested for mains, and so forth, in the outlying districts, clearly the last £100,000 had been improvidently spent, or else they must have a large reserve of capacity. What did they want the £100,000 for? Was it for the purpose—legitimate enough in a commercial undertaking—of increasing the capital of the Norwich station, so as to raise the income of the Company? Look at the hardship of this request. Not being under the auction clauses or the sliding-scale, the Norwich consumers were left to the general provisions as to reduction of price under the Gas-Works Clauses Act. They could, under certain circumstances, apply to Quarter Sessions when the Company, in one year, paid a dividend of more than a certain amount and their reserve fund was full. But the larger the capital was made, the longer the possibility of making such an application would be postponed, because there must be a dividend paid up to a certain amount on the whole capital invested, and the reserve fund must be full, before Quarter Sessions could come in at all. If the modern gas legislation were applicable to this case, the Corporation might be indifferent, as the sliding-scale made the consumer and the Company partners in the price of gas. They suffered by bad management, and benefited if, by economy, they were able to reduce the price of gas and at the same time add to their dividends. The sliding-scale, however, could not be given to Norwich; and it was this fact that made the Corporation so anxious that there should be no further facilities given to the Company, unless it was absolutely essential, not in their own interest, but in that of the gas consumers. Where was there a particle of evidence to show that extensions of the works were necessary, or that there was any deficiency in the supply? Nowhere. This was a case in which the Committee ought to exercise the most jealous and scrupulous supervision over the application of the Company. The first point he urged, then, was this: He asked the Committee to look most carefully at the demand made by the Company Did they want anything; and if they did, how much, and on what terms should they raise it? Let it be only on condition that they did not encumber the consumers of Norwich with an undue charge. Though he might run the risk of offending his clients by the admission, as a rule he (Mr. Pope) was not favourable to the transfer of gas undertakings to corporations, since the auction clauses and sliding-scale had been adopted. In some instances it might, and in others it might not, be desirable; but as an abstract principle, he should not advocate it. In the present case, however, where they could not have the protection which Parliament had said should be given to consumers, and which had removed much of the argument in favour of transferring these undertakings to corporations, he was in favour of it.

In this instance, the Corporation should be empowered to take over the gas supply. He understood that it was objected that there was a district supplied by the Company outside the authority of the Norwich Corporation; but even in such a case that it was not unusual to allow the Corporation to take over the supply. This power, however, was not sought in the Bill. The Corporation could not ask for authority to supply the consumers in the outside districts, as the consent of the residents had not been formally obtained. Debenture stock should be issued in the market to secure that the capital required would be raised with the least possible burden upon the consumers. He submitted that if the Corporation should bring in a Bill for the acquisition of the gas undertaking next year, or at some subsequent period, it should be provided that the Company should not oppose it on principle, but only, possibly, on the question of price. He would not go into details as to what, in the view of the Corporation, the Company ought to do to benefit the consumers, and to maintain and develop their works, beyond saying that they (the Corporation) ought to have a better audit. They should be able to go into questions of mismanagement, of price and purity of gas, and so forth; but he would not dwell upon these special matters, which would only be applicable in the event of the Committee finding that power should be given to the Company to spend further capital on their Norwich works. He preferred to leave the question just now on the points he had indicated—first, did the Company want more money for their Norwich station at all; and, further, if they had shown any necessity, how much money should they have, and how should it be raised? He contended that if power was given them to spend money, it should be on condition that it was raised in the cheapest possible form, so as to make it the least possible burden on the gas consumers. Whether they obtained the money by debentures or stock, he held that this was the case of all cases in which he was entitled to seek to protect the consumers, by enabling the public authority who represented them, to acquire the gas undertaking, and secure provisions such as would be obtained if the undertaking were under the ordinary gas law.

The CHAIRMAN: Is it unprecedented that a Gas Bill should be passed in this House without these two provisions—the auction clauses and the sliding-scale clause?

Mr. POPE: It is a Standing Order that, when application is made for new capital, the auction clauses and sliding-scale shall be inserted in the Bill.

The CHAIRMAN: Is there any precedent to the contrary?

Mr. BALFOUR BROWNE: Yes, my Lord, in the case of this very Company.

Mr. POPE said that was so. The only precedent was in connection with the British Gaslight Company. Parliament had hitherto felt that it could not undo the legislation of 1858, which authorized these things to be done by a limited liability company. The fact that it was an unlimited company should make the Committee very careful as to the powers they granted, and should make them look with favour on the desire of the municipal authorities to acquire the works. He did not think this point had ever been raised before as distinctly as on the present occasion. When, in the case of their Hanley station, the Company came to Parliament last year, a compromise clause was decided on.

Lord KINNAIRD: Do you know what the clause was?

Mr. POPE: I do, my Lord; but that would not satisfy us.

Lord STANMORE: I understand that one of your points is that, if the extension of works for which the Company ask is refused, there is no danger of the gas consumers suffering?

Mr. POPE said that was so.

Mr. BALFOUR BROWNE then replied for the promoters. He declared that there was a fallacy in every one of his learned friend's arguments. First, Mr. Pope said that the Company did not want the Bill at all; and that came of his learned friend not having heard the evidence. He had not been in the room during the whole of the inquiry, and had missed a great deal of the evidence. Statements of the strongest kind had been made by the Company's witnesses, to the effect that the Bill was very much needed. In his evidence, Mr. F. L. Linging said that the whole of the capital authorized had been expended, and that further capital powers were absolutely necessary, unless the city was to be in darkness. Then came the Manager, who also said that in his opinion it was essential that the Company should have further capital. Did the Company want the Bill at all, asked Mr. Pope? Here they had two gentlemen saying, not only that it was needed, but that they could not do without it. Then Mr. Pope said: "If they want capital, how much do they want?" The learned gentleman, if he had heard the evidence, would have seen that the Company required in the immediate future £13,500 for extensions of plant; that they had spent £5300, or thereabouts, beyond their capital powers; that they wanted £1570 to pay for the land they had secured; and that in the next fifteen years, even if they went on exactly as they had done on the average of the past five years, they would want £64,000 altogether. A sum of £2700 a year was required for extensions of plant. Why should this be stopped? Now he came to Mr. Pope's third point—namely, if fresh capital were allowed, on what terms should it be raised? His learned friend argued this as a matter of general principle, and declared that the auction clauses and the sliding-scale were invariably inserted in Gas Bills nowadays. But he forgot that the sliding-scale was in favour of a gas company; enabling them to increase their dividend by ½ per cent. for every penny reduction in the price of gas. So useful was this provision to gas companies, that the South Metropolitan Company under it were able to appropriate a dividend of 12½ per cent. Then his learned friend admitted that if the Bill did what they wanted, the Corporation of Norwich would not wish to purchase the undertaking. He (Mr. Balfour Browne) contended that, so far as raising money cheaply was concerned, the Bill would do what the petitioners desired. The auction clauses said that the consumers should pay as little as possible; and if this could be effected by other means, these clauses were not necessary. Mr. Corbet Woodall had shown them a way of doing it. He had said that the Company would consent to the raising of £60,000 on debentures, at the lowest possible rate of interest—probably 3½ per cent. The witness had told them that this would be a lower rate than even the auction clauses would produce. The question the Committee had to ask themselves was whether the Bill was in the interest of the Company or of the consumers. He maintained that it was in the interest of the consumers alone. His learned friend had said: "Make them raise the whole £100,000 by debentures." This would strike one as specious; but it would not do. No Company in the world could raise every penny of capital by debentures; or, if they did, they would have to borrow at an enormous rate of interest. The only reason that debentures issued at a low rate was because they were covered by the ordinary stock; and the rule adopted by Parliament was only to allow companies to borrow one-fourth of their whole paid-up capital, in order that the people who lent the money might be thoroughly protected. In this case, they offered to raise one-third, finding that the Company could bear it; and, in addition, they offered that the gas supplied should be of 15-candle power—there being no penalty so long as it did not fall below 14½ candles. He thought that, under these circumstances, the Bill should pass; and he confidently appealed to the Committee to allow it to proceed.

The room was then cleared. On the readmission of the public,

The CHAIRMAN said: The Committee are unanimously of opinion that the Bill should be allowed to proceed, on condition that a clause is inserted on the lines of that put into the Staffordshire Potteries Act of 1895, providing that the money must be borrowed on the best possible terms at the time of borrowing, and that the power of the gas be raised to 15 candles, but that no penalty be attached so long as it is not below 14½ candles.

Mr. FREEMAN: Does the ruling you give, my Lord, apply as to the amount of capital, or is it intended that the Company shall have the sum they ask for? The Staffordshire Act deals with an unspecified capital, so far as I can judge.

The CHAIRMAN: The ruling has reference to the amount asked for.

Asked if they were prepared to discuss clauses,

Mr. FREEMAN, for the petitioners, said they did not intend to do so.

The proceedings were then adjourned, in order to allow the clauses to be amended in accordance with their Lordships' ruling.

Wednesday, March 18.

At the sitting of the Committee this morning, the clauses and proviso directed by their Lordships to be inserted in the Bill were approved. A proviso was added to clause 5, which stood in the Bill as follows:—

Notwithstanding anything in the Act of 1858 or the Act of 1875 contained, the Company may, upon the lands described in the Schedule to this Act, if and when acquired by them, construct, make, and maintain, alter, improve, and enlarge, extend, renew, and discontinue works for the manufacture, storage, and supply of gas, and for the manufacture, conversion, utilization, and storage of residual products producible or resulting from or used in the manufacture of gas, and may manufacture, store, and supply, on and from the said lands and works, gas and such residual products, and may erect, make, and maintain thereon all such buildings, works, apparatus, and conveniences as may be necessary or expedient for the purposes aforesaid.

The proviso added is:—

Provided always that no lands within the limits of the Act of 1858 shall be used by the Company for the purpose of manufacturing gas or residual products, except the lands referred to in section 11 of the Act of 1858 and the lands described in the Schedule to this Act; and no lands within the said limits shall be used by the Company for the storage of gas, except the lands in this proviso before referred to and the lands described in the Schedule to the Act of 1875.

The new clauses are:—

6.—Notwithstanding anything contained in section 7 of the Act of 1875, the gas to be supplied by the Company within the limits of the Act of 1858 shall be of such quality as to produce, from the prescribed burner, a light equal in intensity to that produced by 15 sperm candles of six in the pound burning 120 grains per hour. Provided that no penalty shall accrue or be recoverable against the Company on account of the illuminating power being less than that prescribed by this section, if it be proved to the satisfaction of the Justices referred to in section 36 of the Gas-Works Clauses Act, 1871, that the gas is of such quality as to produce a light equal in intensity to that produced by 14½ such candles.

7.—The Company shall forward to the Registrar of Joint-Stock Companies a printed copy of this Act, and it shall be recorded by him; and if such copy is not forwarded within three months from the passing of this Act, the Company shall incur a penalty not exceeding £2 for every day after the expiration of those three months during which the copy is omitted to be forwarded, and every Director and Manager of the Company who knowingly and wilfully authorizes or permits such default shall incur the like penalty, and every penalty under this Act shall be recoverable summarily.

The Bill, as amended, was then passed, and ordered to be reported to the House.

The Brighton Corporation and the Shoreham Water-Works.—The Bill promoted by the Brighton Corporation to enable them to acquire the Shoreham Water-Works was before a Select Committee of the House of Commons last week. Opposition was offered by the District Councils of Hove, Shoreham, and East and West Steyning. After Alderman Reeves had furnished some historical particulars as to the water supply of Brighton, and engineering and statistical evidence had been given by Mr. J. Johnston, Assoc.M.Inst.C.E., the Water Engineer, and by Mr. H. M. Stevens, the Borough Accountant, an agreement was come to with the Shoreham and Steyning Councils whereby they will be supplied with water upon more favourable terms than they are at present. Their opposition was therefore withdrawn. Hove, however, still opposed; and witnesses were called. The Committee eventually passed the Bill, with amendments; and it was subsequently reported to the House. They inserted provisions with respect to the water-rates to be charged by the Corporation within the district of the Company whose undertaking is transferred to them; but as it was not proposed by the Bill to otherwise alter the existing enactments, which have been in force for many years in the district, and have apparently worked satisfactorily, the Committee did not think it desirable to further amend these.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Wednesday, March 18.

(*Before Mr. Justice* KEKEWICH.)

Patterson v. The Gaslight and Coke Company.

This was an action for an injunction, restraining the defendant Company from stopping the gas from entering the premises known as the Albert Bridge Flour Mills, occupied by Messrs. Marriage, Neave, and Co., Limited, who had recently gone into liquidation; the business being carried on by a Receiver and Manager for the debenture holders (see *ante*, p. 521).

Mr. RENSHAW, Q.C., and Mr. KIRBY appeared for the plaintiffs; Mr. WARRINGTON, Q.C., and Mr. DANCKWERTS, for defendants.

Mr. RENSHAW said the plaintiffs Patterson and Stephens were really suing as Receivers appointed by the Court on Feb. 17, at the instance of the first debenture holders, under the powers of the Trust Deed.

Mr. WARRINGTON remaked that his point was that the Receiver under the deed was deemed to be the agent of the Company.

Mr. RENSHAW said the deed empowered the Receiver to enter and carry on the business. On Feb. 7, Patterson, who was appointed Receiver for the second debenture holders, entered into possession; and on the 17th, an order was made appointing Patterson and Stephens Receivers and Managers on behalf of the first debenture holders. At this time, there was £90 14s. 5d. due to the Company for gas supplied. and on the 27th the Company wrote stating that they would be compelled to discontinue the supply unless they received a cheque for the Christmas account, and a guarantee to pay for all gas consumed after then. They also called attention to a decision of Mr. Justice Vaughan Williams, relating to the Bon Marché at Brixton. After some further correspondence, the Company undertook, on terms, not to cut off the supply.

Justice KEKEWICH: Are the Company bound to supply anyone within their district on the signing of a contract?

Mr. RENSHAW: Yes, if he is an owner and occupier.

Mr. WARRINGTON: They are entitled to have security.

Mr. RENSHAW said the real question was whether the Receivers and Managers were "occupiers" within the meaning of the Act. If so, they were entitled to a supply without being liable to pay for the arrears of the previous occupier—viz., the Mill Company. *In re Smith ex parte Mason* (1893, 1 Q.B.D.)* the Trustee in Bankruptcy applied for an order that the South Metropolitan Gas Company should be compelled to repay the sum of £173, being moneys of the bankrupt paid under protest, in order to obtain a reconnection of gas supply to the business premises of the bankrupt. Mr. Justice Vaughan Williams then decided that the Trustee was not entitled to recover back the money, as the debtor continued to be the occupier of the premises; and consequently there was no obligation on the part of the Company to supply gas without payment of the arrears due to them. He submitted that this case was distinguishable from the present, because, among other grounds, the Receiver was also Manager, and he only became the occupier as and from Feb. 17.

Mr. WARRINGTON said the real question was whether the occupation by the Receivers and Managers was a continuation of the occupation of the Company. If so, they were not entitled to a supply without paying the arrears. If it was not a continuation of the occupation of the Company, but a fresh occupation, then they had not entitled themselves to a supply. His third point was that if there was a break of occupation, and they were to be treated as incoming tenants, they became incoming tenants within the meaning of the section on behalf of the first debenture holders, who had paid a consideration.

Justice KEKEWICH: Have you not put your three points a little out of order?

Mr. WARRINGTON said logically the third point ought to be second.

Justice KEKEWICH: You may be right on the second point; but that is not the matter dealt with in the correspondence.

Mr. WARRINGTON said the only question raised was whether the Company were entitled to cut off the supply of gas.

Justice KEKEWICH: They are not entitled to a supply of gas until they have signed a contract, and, if so required, given security; but you have never asked them to do that.

Mr. WARRINGTON said his point was that the plaintiffs had never applied at all as fresh occupiers; they were only applying as a continuation of the old occupation. The trust deed clearly gave the debenture holders power to enter on default occurring, but did not determine the possession of the Mill Company. After referring to the judgment of Mr. Justice Williams in *re Smith*, he submitted that plaintiffs were not owners or occupiers and therefore could not recover.

Justice KEKEWICH, in delivering judgment, said: There are three questions to be decided; and I will deal with them separately. The first is whether the plaintiffs, as Receivers and Managers appointed by the order of Feb. 17, 1896, are occupiers entitled now to a supply of gas, coming in to possession for the first time, and therefore not as successors to the preceding occupier, so as to hold on his behalf without any change of occupation, but as new occupiers, not bound to pay for the gas supplied to their predecessors. It seems to me to be clear, on the different clauses of the Acts of Parliament, that they are new occupiers in that sense, were it not for the case of Smith, which is relied upon by the defendants. It is not hardly argued that, on the construction of the words of the different Acts, the defendants are right, unless this decision supports their view. Now, it seems to me that this decision was entirely on a different state of circumstances. The Court was there dealing with the Official Receiver; and it was argued—and the judgment proceeds on the argument being sound—that the debtor remained the occupier of the premises. It was perfectly clear without argument, on the authority of *Rhodes v. Dawson*, that the receiving order had not divested the debtor of his property. The real question was whether there was any change of occupation; and Mr. Justice Vaughan Williams held that there was none—that is to say, the Official Receiver on coming in succeeded to the debtor, occupying in his name and on his behalf. It seems to me that these plaintiffs are in an entirely different position. They are Receivers and Managers appointed by the Court, at the instance of certain debenture holders; and they come in simply by virtue of the order of the Court ousting the Company which issued the debentures, who had been in possession up to that time. This appears to me to amount to an entire change of occupation. The case of Smith being out of the way, it seems to me to be reasonably clear that they are new occupiers, entitled on proper terms to be supplied with gas; and that they are not liable to pay, as a condition or otherwise, the rent for the gas supplied up to the date of their occupation. Then the second point is this: It is said that they are liable under section 18 of the Act of 1872, because, though they may be incoming tenants continuing to carry on the business of the outgoing tenants—that is to say, of Messrs. Marriage, Neave, and Co., Limited—whom they succeeded, they come within the exception, because they have paid to the owners, mortgagees, or lessees in possession (the outgoing tenants) a consideration for so doing. It cannot be contended that Messrs. Patterson and Stephens have themselves paid any consideration to the Company, or to anybody else, for continuing the trade and business, which I apprehend is what is referred to by the words "so doing." But it is argued they only came into possession as the representatives of the debenture holders; and the debenture holders necessarily advanced money to the Company, and thereby got a charge on the business; and that they are continuing the trade in consequence of having paid that consideration. I leave open the question how the section is to be construed, if it should ever arise, in the case of a mortgagee entering into possession of the estate of the mortgager. Here it is simply Managers and Receivers. They are principals, and are liable to be sued for any debts incurred in carrying on the business. They are personally liable; they have paid no consideration to the Company. It seems to me therefore, that they do not fall within the exception. Probably these are the two most important points to the parties concerned—at any rate, with a view to future dealing with other people. But another point arises, which is of some little importance, because, to my mind, it affects the question of costs—that is, whether Patterson and Stephens are now entitled to have a supply of gas. In considering this part of the case, I assume I have rightly decided that they were new occupiers. The Gas Company were not bound to supply new occupiers unless proper request was made, the terms of the Act complied with, a contract signed to pay the rent, and, if required, give security, according to the terms of the Act of Parliament. The Gas Company would scarcely be said in that way to cut off or—to use a less ugly word—to discontinue the supply of gas; it is a new supply. It does so happen that the mains are there, the meter is there, and everything is ready; and in many ways it is continuing the old supply—that is a fact to which I will advert presently. But as each new occupier comes in, he is not bound by the contract of his predecessor. It is to all intents and purposes a new supply; and there ought to be a fresh contract, and, if required, new security. The Company would be perfectly right, finding there was a new occupier, in saying: "We shall not supply you until you comply with the terms of the Act of Parliament. We cannot recognize the contract with your predecessor; we must have a new one with you." This seems reasonable enough; but unfortunately the Company desire to bring this question of the liability for the last quarter's rent, and it appears to me they have rather lost in insisting on that. I think the plaintiffs, while denying the right of the Company to cut them off on the ground that they would not pay the £90, were bound to give a proper notice under the Act, or security if required. They should have tendered whatever was necessary, and given proper notice under section 11 of the Act of 1871. When I come to consider whose fault that was, I cannot help arriving at the conclusion that the Gas Company were to blame. The plaintiffs seem to have forgotten that it was necessary for them to give notice of their appointment to the Gas Company; and, as I conclude from the letter of Feb. 26, they never did it, until by some accident they became acquainted with the final notice which was left at the premises by the collector. They began thus: They first gave notice they were appointed Receivers and Managers; and then they said: "We are now carrying on the business on behalf of the debenture holders, and hereby give you notice that we are desirous of being supplied with gas, and of becoming your renters for all gas consumed by us on and from the 7th inst.; and we are prepared to pay for same as you may desire." They did not go on to say they were prepared to sign a contract, or to give security if wanted; they left it for the Company to indicate what was right. To that the Company replied, not tendering a proper contract or asking for security, but referring simply to the final notice, and saying: "We shall be reluctantly compelled to discontinue the supply of gas on Tuesday next, in accordance with the terms of our final notice, unless we receive a cheque for £90, and a guarantee for payment for all gas consumed from December last. No doubt there was never any explicit acceptance of the terms that the plaintiffs were to give a guarantee for the gas consumed from December last by itself, nor was any contract signed; but the Company insisted on that specific thing. The last was an additional requirement which the Company were entitled to insist on fairly; but they mixed it up with the demand for the £90. I cannot say the plaintiffs were wrong in testing that, and omitting to comply with the other terms; because, according to this notice, the Company would not have been satisfied with anything less than the £90, and would not have accepted a contract and security. It seems to me, therefore, that the Gas Company put themselves entirely in the wrong. Then it was argued for the Company that the plaintiffs were wrong; for the reason that they did not serve a notice on the Company, specifying the premises in respect of which a supply was required, and the day from which the supply was to commence. It appears to me that they did give reasonable notice specifying the premises; but then there is the question whether they specified the day. They named the 7th of February. There is all the difference between a new occupier going into vacant premises, and a tenant taking possession of premises—the gas-meter being there, and the service-pipes in

* See "JOURNAL," Vol. LX., p. 820.

connection with the main. I think the defendants were wrong on all points; and that the injunction must go. The plaintiffs must undertake to sign a proper contract for the supply of gas to these premises as from Feb. 7, and to give such security, if necessary, as they are required to give pursuant to the terms of the Act.

Mr. DANCKWERTS: It must be a contract for two years.

Mr. RENSHAW said he was willing to give the undertaking; but there was a difficulty about the injunction. He should be content with the following declaration: Declare that the plaintiffs are not liable to pay any arrears for gas or meter-rent in respect of the premises which accrued due, or became payable, prior to Feb. 7, 1896, as a condition precedent for the supply of gas.

Mr. WARRINGTON said there ought to be in addition a declaration that the plaintiffs were liable to pay for the gas as from Feb. 7, and were entitled to a continuance of that supply on signing a proper contract.

Mr. RENSHAW offered no objection to this addition.

Justice KEKEWICH: Defendants must pay the costs of the action.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Saturday, March 21.

(*Before Mr. Justice* CHITTY.)

Incandescent Gas-Light Company, Limited, v. Ilesford and Others.

These were actions for infringement of three patents of 1885, 1886, and 1893, and asking for injunctions, for an inquiry as to damages, and for costs as between solicitor and client. They came on as short causes, on motion for judgment, in default of appearance.

Mr. WALTER, who appeared for the plaintiffs, said the particulars of breaches alleged infringement by the sale of infringing mantles, and also by the use of the plaintiff Company's mantles in breach of the limited licence under which they were sold, by using them with burners not made by the Company.

Justice CHITTY made the first order as asked.

His Lordship next had before him three other actions brought by the Company; defendants being Messrs. Rutter, Abbott, and Wilson.

Mr. WALTER said these cases were the same in all respects as the one just heard—no appearance having been entered by defendants.

The same order was made in each case.

(*Before Mr. Justice* NORTH.)

Incandescent Gas-Light Company v. Johnson.—Same v. Potter.

The first of these cases was a similar action, and it also came on as a short cause; there being no appearance for the defendant.

Mr. GRAY, having stated the nature of the case, and quoted a portion of Mr. Justice Wills's judgment in Cantelo's case,

Justice NORTH pointed out that there was nothing in the statement of claim as to a breach of the limited licence; and he said he could not therefore put in the injunction any words directed to that. It would be simply an injunction against infringement, an inquiry as to damages, and costs down to the hearing.

In the second case, the only infringement complained of was a breach of the limited licence, by using plaintiffs' mantles on burners not supplied by them. The defendant had entered an appearance; but he had not put in any defence. His Lordship made the same order as in Johnson's case.

(*Before Mr. Justice* STIRLING.)

Incandescent Gas-Light Company v. Batts.—Same v. Skinner.

The action against Mr. Betts was similar in all respects to those heard by Mr. Justice Chitty, and his Lordship granted an injunction restraining infringement of the patents, and an inquiry as to damages; the cost of the inquiry being reserved. A similar order was made in the other case; there being no appearance on behalf of the defendant.

(*Before Mr. Justice* KEKEWICH.)

Incandescent Gas-Light Company v. See.

In this case, which also came before the Court as a short cause, owing to the defendant not having put in a defence, a similar order was made as in the previous cases.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Saturday, March 21.

(*Before Mr. Justice* DAY.)

Dawson Gas-Engine Syndicate, Limited, v. Webster.

This was an action to recover the sum of £210, being the price of a gas-engine and dynamo. The defendant alleged that they did not, according to contract, give an output of 4500 watts continuously. The plaintiffs replied that the machines were tested before delivery, in the presence of the defendant and other persons, and they furnished 4500 watts, which was the quantity stipulated; but the defendant had worked the dynamo with a view to getting 6000 watts out of it.

Mr. WALTER appeared for the plaintiffs; Mr. W. H. MORESBY represented the defendant.

His LORDSHIP, after hearing evidence on both sides, gave judgment for the plaintiffs for the amount claimed.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, March 16.

(*Before Mr. Justice* WILLS.)

The Incandescent Gas-Light Company v. The De Mare Incandescent Gas-Light System, Limited, and Others.

On the trial of this action being resumed,

Mr. BOUSFIELD continued his address on behalf of the defendants. He said he wanted just to complete his reference to the case of *Nobel's Explosives Company v. Anderson*. Quoting from the argument of Mr. Moulton, and some observations by the Lord Chancellor in that case, he contended that his friends had to show, in this action, that a compound of zirconia and of erbia—or, if he might put it more broadly, a compound leaving out one of the two minerals or its equivalent, namely, lanthana, which the patent specified—would have been known to a chemist to give substantially the same resulting consequences as the compound which was mentioned in the specification. Still relying upon Nobel's case, he submitted, moreover, that, when a patentee had limited himself to a particular combination, it would not do afterwards to say that he had found out that other combinations would answer, and that therefore these other combinations were an infringement.

Justice WILLS supposed that if, instead of using the particular combination, he used that which, if it were in mechanics, one would say was a "mechanical equivalent" for it, then his patent would still cover that.

Mr. BOUSFIELD assented. If it was a known equivalent at the date.

Justice WILLS: Certainly. Of course, a discovery afterwards would not do.

Mr. BOUSFIELD submitted that, in chemistry, they must know that an equivalent was an equivalent at the date of the patent. Otherwise, it was not an admissible equivalent. This was shown by the oldest case he had cited, in which all the Judges were called to give their opinion in the House of Lords. Upon the question of equivalents, and the language of the specification, an important case was that of *Nettlefolds v. Reynolds*. The patent here related to making wood screws by rolling them with suitable dies. The plaintiff's claim included the word "cylindrical," and was for an apparatus in which screws were rolled by means of cylindrical dies, and so on; and the defendants did theirs with straight dies. This was the main point on which the question turned. It was a judgment of Mr. Justice Romer's; and it went to the Court of Appeal. It was there decided that, as the patentee limited himself to cylindrical, he could not be heard to say that straight dies were an infringement. The case applied strongly to the present one. If all the plaintiffs had claimed was a certain material, they could not then say that the patent included something else. All the authorities showed that one-half of the function of a specification was to inform the public what were the limits of the invention; so that, in a case like the present one, the public might not be in doubt until they had heard a great deal of evidence as to what the patentee meant. Of course, it was difficult sometimes; and the public had to put up with difficulties that occurred.

Justice WILLS said the office of the patent agent, on the one hand, while making the specification sufficiently distinct to prevent its being said that the patent was of no use, because nobody could tell what it meant, was to make it as elastic in the other direction as possible; so that, if the patent was attacked on the ground of want of novelty, he might be able to say: "Oh, but these things you say were anticipations are excluded because I do not claim them." On the other hand, if he did not happen to be in this difficulty, and there was infringement, he wanted to make it capable of as large a construction as he could. Therefore, to a certain extent the object of the patent agent was to make it difficult for anybody who had to deal with it to construe it.

Mr. BOUSFIELD admitted that these were the principles upon which patent draughtsmen would go. But, after all, the authorities went to show that, where the specification was difficult, the patentee must be held to it. There was a clearness and a distinctness about part of the plaintiffs' specification, which was absolute. When a man said distinctly: "I employ a compound of two things"—and gave the proportions—"or three things;" and then said: "You might dispense with one of them, and make the compound of two things, and for one of those things you might substitute an equivalent, and for another another equivalent"—that, so far as definiteness could go, was limiting what was intended to be the meaning of the specification, because if he had been minded he might have said: "Any of these rare oxides will give a result, some less advantageously than others." It would have been very easy to have done this. But, instead of that, what did the patentee do? He filed a specification, in which he set out what he said was a new discovery; and afterwards he stated that, since filing the provisional specification, he had found that certain substances other than those mentioned therein could be beneficially employed in producing illuminant appliances, and separate protection was taken out for them.

Justice WILLS remarked that that was very well as an illustration; but he must guard himself against accepting it as other than argument.

Mr. BOUSFIELD submitted that it was obvious one specification could not be construed by another.

Justice WILLS said the patentee could not get any benefit to himself by having any other specification; and he ought not to get any detriment.

Mr. BOUSFIELD submitted that he did not want the help of the second specification to show that there was a perfectly definite specification limited to definite substances and definite equivalents. In support of this contention, he referred to several passages of the specification itself. His learned friend, in opening the case, had said that any of the rare oxides would do to make a mantle, and "any" were claimed, because of the substances mentioned. But with regard to this, he made two points. First of all—as had been constantly pointed out by the Courts—a claim was not put into a specification to extend the scope of the specification, but to limit it. The object of a claim—as had been said judicially on more than one occasion—was to

act as a disclaimer. The object of a claim was to modify a description that went before. A claim could not operate to extend the meaning of the specification. Secondly, he contended that every claim referred back to the specification; one had to go back to see what was mentioned. Upon doing so, they found the compound alluded to was that of zirconia and lanthanum; next a compound of zirconia, lanthanum, and yttrium—that was, in either of those two, ytterite earth was substituted for yttrium. Again, cerite earth could be substituted for lanthanum; and, for the zirconia, they might take magnesia and zirconia. It was clear that it was not right to read a claim as extending a specific description.

Justice WILLS did not quite understand how far the argument for the defendants went. Was it contended that if another person used everything that was under the patent except ammonia gas, and left that out, that this would not be an infringement?

Mr. BOUSFIELD said that was his contention. It would have been perfectly easy for the draughtsman to have put in words showing that it was optional whether the fabric was exposed to ammonia gas. Everything in the present case pointed to the intention of the patentee to make a limited claim. Why he should have done it, one could not say. There was, perhaps, more information on the Continent than there was here; and instructions came from the Continent on matters of this sort.

Justice WILLS said an inventor might be in a certain difficulty, which explained oftentimes why claims were different from what they would have been if an inventor could have known what he knew two years afterwards. He probably knew there were half-a-dozen other people on the same track as himself; and, if he did not hurry, he ran the risk of somebody being before him. Very often, he could not complete his experiments, in order to enable him to make the most beneficial use of his knowledge, for fear of somebody else getting in before him.

Mr. BOUSFIELD said what was done was this: A man completed his patent for what he had discovered; and he immediately set to work to take out other patents for what he discovered afterwards. A patentee, when he filed his complete specification, was bound to give the public the best information up to that date which he could. The claim to use thorium was not here covered by the specification. After referring to Mr. Swinburne's evidence, as to the meaning of the words "cerite earths," and several books on chemistry, the learned Counsel submitted that the statement that "cerite earth was a mixture or blend of rare oxides obtained from the raw material cerite," was in absolute accordance with his case. Cerite earth was the oxide obtained from the mineral cerite. The common knowledge as to the constitution of cerite at the date in question was that it consisted of lanthanum, didymium, and cerium, with small amounts of iron of calcium. The only other point which he need deal with was that about ammonia gas, comment upon which he would leave until after evidence had been given. Evidence would also be adduced as to the proper position of the patent. Mr. Sugg would say that in 1887 Welsbach came over to this country, and put this invention before him; but as the mantles were so fragile, Mr. Sugg reported that they were of no use commercially, and declined to take them up. It was not necessary to indicate at greater length the evidence which would be put before his Lordship. As regards the Directors of the Company, who had been made defendants, he would ask for a non-suit, as no evidence had been given at all about them. It was only by a mere technicality that they could be joined at all. However, anything he had to say on this point he would reserve till a later stage.

Dr. *Otto Hehner*, examined by Mr. BOUSFIELD, said he was Past-President of the Society of Public Analysts, Examiner of the Institute of Chemists, and Public Analyst for Nottingham and a number of other places and counties. He had thoroughly studied Williams's specification, and could very plainly see the train of thought which was in the inventor's mind. He might at once say that he did not pretend to understand every single clause of this exceptionally difficult specification. The title was a very wide one; and a great many clauses were spent upon the principles of the whole thing. First of all, the bunsen burners and the regenerative burners were described in detail, then the chimneys, and also two kinds of mantles—one strong and durable, and one more feeble. All sorts of combinations which might be used were claimed; and then the specification explained, in more or less detail, how to manufacture. The specification stated: "I build up or form the light-emitting portions of my thermo-candle or lamp by the deposition of metal or metal alloys upon an earthy material or compound, such as zirconia, gypsum, lime, fire-clay, asbestos, or other comparatively indestructible material or compound." This was perfectly intelligible, and perfectly plain. The thermo-candle there referred to meant depositing the incandescence upon an indestructible base. A plain distinction was drawn between the light-giving portions of the candle and the thermo-candle itself. The whole apparatus was the thermo-candle, and the light-giving portion was what might be called a mantle. Witness pointed to several passages in the specification which, if properly followed, would enable a person to make a mantle.

Justice WILLS said, if these were really anticipations, there was very little left for the public to work on after Williams's specification.

Mr. MOULTON remarked that it included the rest of the history of the world.

Mr. BOUSFIELD: Except to find out substances which would give a bright light. He suggested that it was because of this particular specification, or of some knowledge of the sort, that the patent had been limited to the substances named in the specification, and treated in the manner mentioned there. He did not contend that this anticipated the particular substances or the mode of treatment.

Examination continued: He had prepared a mantle by taking one of the indestructible forms mentioned in the specification, and dipping it in chloride. When a fibre was dipped into salt of platinum and burnt, a residue of metallic platinum was produced. Witness formed another mantle which he first dipped into zirconium nitrate. He afterwards dipped the fabric so impregnated into a solution of magnesium, which when burnt would produce a coherent form. There was no information in the plaintiffs' specification as to how the mantles should be burnt in order to produce a satisfactory result. [The mantle which witness referred to was produced and burnt in Court.] He had heard, with astonishment, that Stokes-Williams applied the same sort of thing for electrical purposes, and for purposes of incandescence with the gas-flame. He could not see what difference it made in principle whether the heat was applied in the form of gas or in the form of electricity. The light depended on the temperature to which it was raised. There was no difficulty whatever in making a coherent mantle (as described in the specification) of magnesium and zirconium. A mantle so made would give a light. Witness also produced other mantles which he had made according to Williams's specification; and they were burnt before his Lordship. He had read the papers with reference to the Frankenstein lamp, and found that they did not agree as to the exact directions. In the first case, it was directed that the mixture of magnesium and caustic lime should be taken; and, in the second, that a mixture of magnesium and carbonate of lime or chalk must be taken. He had made numberless experiments following out the exact directions of Frankenstein; and, out of a very large number, he had only been able twice to get something like a tolerable mantle. It was practically impossible, by following Frankenstein's directions, to get a mantle which could be handled, or which would be useful. To properly carry out Frankenstein's idea, it was necessary to add a pinch of salt or a small quantity of soluble matter. In Talbot's paper, the direction was to take some soluble matter and steep it. That gave him, in fact, the idea of adding some small amount of soluble matter to Frankenstein's. Anybody knowing these two papers, could have made a mantle from them. Taking a paper and treating it as Talbot advised, a coherent structure was produced—a body which incandesced when put in a flame. A very small body was obtained which had a pretty little incandescence.

Mr. BOUSFIELD: In principle, can you distinguish between the body you obtained and the mantle made in plaintiffs' specification?

Witness: The principle is exactly alike if paper is a fabric. The cerite earth of a certain kind specified in plaintiffs' specification, as an equivalent of lanthanum, did not contain any substantial proportion of the ytterite group. There was no indication whatever that the ytterite group would serve as a substitute for lanthanum. There was no common knowledge of these earths being so employed as mixtures. At line 13 of the specification, it was said the proportions in which the substances were compounded might be varied within certain limits; and he had produced about 500 mantles with different compositions. Some were made with pure salt solutions; and others, with mixtures. In some cases, he found that the proportions were of the utmost importance. Reading the specification with the knowledge existing at the time, no one would come to the conclusion that lanthanum or its equivalent might be left out. The strength of the solution was also a matter of great importance. When he first tried to make mantles according to the specification, he was not able to do so by following the directions. He started originally by taking oxides of zirconia, lanthana, and yttria mixed in the proportions mentioned. He had the utmost difficulty in making any solution of the oxides whatever; and only a person who had specially directed his attention to the subject could get them into a solution at all. They could not be got into solution, except in the case of zirconia by stewing it at a high temperature in strong sulphuric acid. A solution was then obtained of sulphate of zirconia, which the inventor said was not to be used; he said it was the nitrate or acetate that was wanted. Assuming that all were got into solution in the right proportions, the strength of the solution was a matter of great importance. There were no directions as to the strength. A weak solution would not do, and a strong solution would not do. A saturated solution had undoubtedly the fault that it made the mantle too rigid, and gave comparatively little light. A more diluted solution made the mantle shrink to such an unreasonable extent that it could not be used; and it required a good many experiments until the right strength of concentration was obtained. Ultimately, by experimenting, a solution was found which gave a coherent mantle and a reasonable light. The strength varied between one part of the nitrate dissolved in two parts of water, or one part of the nitrate dissolved in three parts of water. These were the best strengths. He had the things necessary to perform the experiment as to the ammonia gas part of the process.

Mr. BOUSFIELD suggested that witness should soak two mantles of the zirconia and lanthana, and let one be exposed to ammonia and the other not; that the mantle should be afterwards dried, and then experimented upon.

Examination continued: He had tried about a hundred mantles with ammonia, and likewise five samples of nitrate of zirconia obtained from three different sources. He had never succeeded in burning a mantle which was ammoniated made with four samples of the nitrate of zirconia. The mantle burnt off; and just when the organic matter had burnt off, it fell to a fine powder. He had numerous samples of ammoniated mantles with him. [An ammoniated mantle prepared by witness was then burnt; and after a short time it fell to pieces.] The flame showed the presence of potash or soda. There was a very small quantity of potassium nitrate impurity in all these, like in all other samples that were purchased. He had one specially to which he had added nitrate of potassium—having heard in Court that this was an explanation. He had added various percentages of potassium salts to perfectly pure zirconium nitrate; and he found that potassium salts, if anything, had a beneficial effect rather than otherwise, because they baked the compound together. He had tried the experiment with the best zirconium nitrate he could purchase; and that was the only one that succeeded. The chemical effect of exposing these salts to ammonia was that oxide of zirconium (which was an insoluble substance) was thrown down. Lanthana also threw down hydrated oxide, but not to the same extent that it did with ammonia lanthana. When the mantle was dried, the zirconia hydrate shrunk to an extraordinary extent. He produced two specimens to illustrate this. Having weighed out two equal quantities of zirconia nitrate, each of 5 grammes, witness dissolved them in water, and added ammonia, with the result that zirconia hydrate was thrown down. This nitrate was diffused over the fibres, and was then dried; the result being that the same quantity shrank together in a hard mass, occupying an exceedingly small bulk, which witness said was the explanation of the fact that these things would not hold together. He had mantles made with magnesia instead of part of zirconia; and having ammoniated them, he found that they did not

fall or break. He had analyzed several of the defendants' fringes, and found they consisted largely of zirconia. There were also present some magnesia and certainly some erbia. He also looked for the absorption spectrum, and found it most plainly.

Justice WILLS: That is of erbia?

Witness: Yes, my Lord.

Cross-examined by Mr. MOULTON: In all cases, the ammoniation was done with ammonia gas; the mantles were never immersed in ammonia fluid. They were first steeped in the solution; the solution was then squeezed out, either by the fingers or rollers; and the damp mantle was exposed to the fumes of ammonia gas, and then dried. After drying, it was immediately burnt. The ammonia experiments were as a rule made upon solutions which contained one part of nitrate in two parts of water, or one part of nitrate in three parts of water. He could only get useful results from about three-and-a-half parts of water to one of the nitrate, to two parts of water to one of the nitrate. These were the best preparations which he found and dissolved to make a mantle of the proper size. He could make a mantle of any solution, but not a useful mantle.

Mr. BOUSFIELD: The light would diminish as it was loaded more.

Witness: Certainly.

Cross-examination continued: A coherent mantle might be made of any solution practically; but the ones which gave the best light were those which contained from 22 to 33 per cent. of the nitrate. He did not think Talbot's process was an anticipation; although by means of it a pretty light was obtained $\frac{1}{2}$ inch square. He had never read Stokes-Williams's specification for electric light. Witness was then taken at some length through Stokes-Williams's specification, and asked whether he could point to any passage which he alleged was an anticipation of plaintiffs'. He pointed to several passages which he alleged were anticipations.

Justice WILLS said Williams's specification had not made much impression on him; and he did not understand Mr. Bousfield to say that it was an anticipation.

In re-examination, witness was asked whether he could take two mantles, immerse them in a solution of lanthanum nitrates, ammoniate one and not the other, dry them both, when one would make a coherent mantle and the other fall to pieces. He replied that he should be happy to do so at any time. [Later in the day, the witness performed the experiment.]

Mr. MOULTON asked whether the plaintiffs could be supplied with a portion of the solution used by witness.

Mr. BOUSFIELD said, if there was to be any analysis, he must ask that Dr. Hehner should be present. They would only supply a sample upon that condition.

Mr. MOULTON said he required the solution for the purpose of having it examined by his experts.

After considerable discussion, it was arranged that the solution should be divided into three parts—one to be handed to the plaintiffs; one to be retained by the defendants; and the third was to be left in the custody of the Court.

Mr. *John Holmes Sheldrake*, the Managing-Director of the defendant Company, was called to prove that in October, 1895, he obtained certain mantles from Mr. De Mare in Paris, which were handed to Dr. Hehner to experiment with.

Cross-examined: Mr. De Mare was not present; but he would be in Court later on. Witness had not received any of the solution from which the mantles were made. He had received small sample bottles of the zirconia, and magnesium and erbium, samples of which were also given to Dr. Hehner. Some of the mixture which contained erbium was at the present time at the Company's offices, Palace Chambers, which, if necessary, he could produce.

Mr. BOUSFIELD said he should decline to produce it. He did not know what was in the solution. The defendants were told that they had manufactured and sold certain fringes mentioned in the particulars of objection, and duplicates of these had been supplied.

Mr. MOULTON pointed out that the defendants threatened to go on making in the same way as this, in accordance with their patent. He supposed witness had got this bottle as a specimen of what De Mare was making the mantle with.

Witness said that was so.

Mr. MOULTON again asked that the solution might be produced.

Mr. BOUSFIELD took upon himself the responsibility of declining to do so.

Justice WILLS asked upon what ground the defendants objected to produce.

Mr. BOUSFIELD said it was quite sufficient to stick to the particulars of objection. The action was in respect of certain definite things; and he declined, except under compulsion, to introduce any fresh element into the case.

Mr. MOULTON said there was very strong evidence as to what these mantles were made of.

Mr. BOUSFIELD: We have your evidence; and I have substantially accepted it.

Mr. MOULTON said it was new to him to learn that a defendant might refuse to produce a piece of evidence which might militate against him.

Justice WILLS said he found it difficult to appreciate the objection. He presumed these things were all made upon a common plan; and the witness said he obtained a solution from Mr. De Mare which was used in the process. He could not see why that should not be produced.

Mr. BOUSFIELD said he must decline to make himself responsible, or his clients, for what might happen to be in the bottle. This was not an action against Mr. De Mare, but against a new Company, which had been formed to make mantles according to a certain specification. He did not know what Mr. De Mare might have in the solution. He had only just heard, for the first time, that such a solution existed.

Justice WILLS thought it would be evidence that this was the stuff ordinarily employed in manufacturing certain "types of infringement."

Mr. BOUSFIELD said that was not the charge. The charge was not that they intended to use a certain solution. They did not intend to be responsible for Mr. De Mare's solutions. The Company had bought the patents, and intended to made mantles of zirconium, erbium, magnesium, and bismuth. Supposing it should turn out that the solution was the identical solution described in the patent, he should entirely disclaim it. The defendants had never threatened to use such a solution, and had no intention of using it. He declined to produce the solution. Perhaps he might be allowed to ask one question of the witness.

Justice WILLS: Certainly.

Mr. BOUSFIELD: Do your Company propose to manufacture these mantles or to import them from France?

Witness: To manufacture them.

Tuesday, March 17.

When the case was resumed this morning,

Mr. MOULTON said the plaintiffs' experts had analyzed the chemicals handed to them by the defendants, and found the zirconium contained about 10 per cent. of impurity—chiefly potassium. They offered their chemicals to the defendants; but they were declined.

Mr. BOUSFIELD said that was not so.

Justice WILLS remarked that it had occurred to him that very possibly the difference between the success and non-success of the experiments with the ammonia depended upon the purity of the materials; but, looking to the character of these things, the patentee, when he spoke of oxides, was entitled to have them pure.

Mr. MOULTON said the experiments had again been repeated with a 10 per cent. solution, carefully tested for magnesia and for thorium. It was found to be pure from both; and mantle after mantle had been made, and burned off with perfect success. The lanthana was from the plaintiff Company; and the zirconia was from Mirck's. He produced bottles of the two substances, and a third containing the 10 per cent. solution made from them, which were handed to the defendants for the purpose of examination by their experts.

Mr. *Arthur E. Abrahams* was then called. He said he was a member of the firm of Michael Abrahams, Sons, and Co., the Solicitors for the defendants. Mr. Robotham was, he believed, one of the promoters of the defendant Company; and in April last, five fringes were supplied, as he was informed, to the plaintiffs by Mr. Robotham. On the 8th of May, the defendant Company was registered; and on the 16th of May, the present action was commenced against them. In October Mr. Lowenthal (from plaintiffs' Solicitors) came and requested to be supplied with some fringes for use by his experts in the approaching trial. Witness informed him the defendants were not manufacturing them here, but that he would send to Paris for some. In October, Mr. Sheldrake brought him half-a-dozen, giving him instructions not to hand them over until Dr. Hehner had examined them, in order to see that they contained a solution proposed to be used by the Company—namely, nitrate of zirconia, 55 per cent.; nitrate of erbium, 30 per cent.; sulphate of magnesia, 10 per cent.; and sulphate of bismuth, 5 per cent. Shortly afterwards, he received instructions from Mr. Sheldrake that the fringes contained what they were represented to contain; and he accordingly wrote the letter which had been already put in, and sent it with them to the plaintiffs' Solicitors.

Cross-examined: Mr. De Mare was one of the vendors to the defendant Company. He (witness) could not say of his own knowledge that he was making these burners in Paris under the name of Héliogène. He had heard so. The defendant Company bought the English patents. He had no knowledge of what the French Company were working. The fringes which he had spoken of were obtained from the Héliogène Company. The prospectus contained the following description: "Over this burner is suspended horizontally a platinum wire, to which is attached a fringe of cotton, which has been previously steeped in a mineral solution and dried. Upon being used for the first time, the cotton is burned out by the gas-flame; the mineral constituents alone remaining in the form of a hanging fringe. This fringe is quickly brought to a white heat; producing a bright, steady, glowing light of great purity, devoid of any green or other objectionable tinge." The fringes handed to Mr. Lowenthal he received from Mr. Sheldrake. This was all he could say with regard to them. He heard Mr. Sheldrake say he wrote for some solution in November last. He had not the letter, and was not aware of it, until Mr. Sheldrake mentioned it.

Mr. MOULTON called for the production of this letter.

Mr. BOUSFIELD declined to produce it.

After considerable discussion,

Justice WILLS said he thought it had better be produced.

Mr. BOUSFIELD said he would send for it.

Sir *Henry Roscoe* was next called, and examined by Mr. BOUSFIELD: He said he had read the plaintiffs' specification; and taking knowledge at the date in question as to the rare earths of a similar character to those named, that knowledge would not have enabled a competent chemist to say that other compounds than those mentioned would serve the purposes the patentee had in view. With regard to ytterite earth and cerite earth, he was of opinion that the latter referred to the mineral cerite.

Justice WILLS said he had already expressed his view on this point the previous day.

Examination continued: Witness had seen the experiments made by Dr. Hehner; the result being as he had stated. With the materials used by Dr. Hehner, the results were certainly against the use of ammonia. There were some cases in which the mantle which had not been ammoniated failed; but he had seen cases in which the mantle which had been previously treated with ammonia was stable. Returning to the specification, he found no indication that the ytterite group, or any member of it, would serve as a substitute for lanthanum in the compound, or that the use of a compound of zirconia and erbia would give the desired results. There was no mention of erbia in the specification. It was common knowledge at the time that erbia when placed in a bunsen flame did give out a bright incandescence; and also that zirconia gave incandescence. But he should not have known that a compound of zirconia and erbia would come within the classes of substances referred to; or that, when applied to a mantle in the manner described, they would give the results mentioned. He should not have known that a mixture of erbia and zirconia would act in a similar way to one of lanthanum and zirconium. In matters of this sort, it was important not only that the particular

material to be employed should be named, but that the relative proportions should also be carefully guarded.

Cross-examined by Mr. MOULTON: Zirconia was precipitated along with cerium, lanthanum, and didymium. Yttrium was not precipitated; but there were several others that were. He should understand by ytterite earth, the rare oxides from the mineral in which the cerium group predominated; but cerite earth he thought meant earth obtained from mineral cerite. There were many other minerals which contained cerium, lanthanum, and didymium. But cerite was a peculiar mineral; and, in his opinion, the term cerite earth really meant the rare oxides obtained from this particular mineral. Orthite was a mineral which contained 12·63 per cent. of cerium oxide and 5·67 per cent. of lanthanum oxide. It was not one of the commonest of the sources of cerium and other metals. Gadolinite was the original source of the erbium or ytterite mineral. Further pressed, witness said he did not consider orthite a cerite mineral, although it contained cerium. According to analyses in Dana, it contained no didymium; but there were certain small quantities of lanthanum. These analyses were, however, made long ago; and the mode of separation was not then properly understood. He was not aware of any analysis of cerite which contained no didymium. Still he could not agree that the word "cerite earth" in the specification referred to the oxides of rare earths in which the cerium sub-group predominated.

By his LORDSHIP: He did not know of any of these mineral substances of this group which, on analysis, were found to contain but little cerium and no didymium.

By Mr. MOULTON: He did not find it in the mineral cerite nor anywhere else. Looking at the particular analysis in his own book, there was no doubt that orthite came nearer the idea expressed in the specification than cerite. But it was scarcely fair to put that one analysis against forty others in Dana.

By his LORDSHIP: In the forty analyses referred to, didymium was present in substantial quantities. The average would be something over 10 per cent.

Cross-examination continued: These minerals differed very largely in proportion in the various earths. Witness was at Heidelberg studying with Bunsen when he discovered the incandescence of erbium in 1866. The knowledge of these substances had greatly advanced since the date of the Welsbach specification; and a new commercial industry had sprung up in consequence. He agreed substantially with Mr. Pringle's description of the Welsbach mantle. He did not think it was quite novel at the date of the specification. It seemed to him (witness) that the general idea of a mantle composed of woven or knitted fibre, impregnated with some salt of an earth or earthy material, was known before the date of the patent. Frankenstein had proposed to make such a mantle. He (witness) had not tried the experiment himself; but he understood Dr. Hehner had done so. There was also an indication of the same thing in Williams's patent. He personally had made no experiments of this character. He had never heard of Williams before this action; but there was a great deal more he had not heard of also. He had not actually made experiments himself. He had been present when Mr. Crookes made an experiment, and at some of Dr. Hehner's. Prior to 1885, it was known that these rare oxides would incandesce, and also that they gave soluble nitrates, and that these nitrates would decompose on heating, and leave the oxides. Taking the whole of these earths, the separation of them one from another was extremely difficult; but their atomic weights had been determined, and there were methods of bringing up the purity of any particular one.

Re-examined: The separation of the cerite group from the ytterite group did not present any difficulty. Of course, it was not known in 1885 that the rare earths which had since been discovered gave soluble nitrates. These rare earths occurred in very varying proportions in different minerals. Of some, there were extremely small traces in one mineral; and in other minerals, a much larger quantity. It could not be said that, if a new earth were discovered, it would give a soluble nitrate, or that all these rare oxides would incandesce in the same way as Bunsen found that erbia would incandesce. Taking phillippium, for instance, that was said to exist in 1885. But he himself happened to put it out of the region of possible elements. He found out that it did not exist, but consisted of a mixture of bodies. He did not think in 1885 anything was known of its incandescent properties. The same might be said with regard to decipium and samarium, and several others. Erbia was discovered a great many years ago; but it was in 1866 that Bunsen found out its bright incandescence. At that time, he did not think Welsbach was at Bunsen's laboratory. The incandescence of erbia was very bright, with a greenish tinge. There was no doubt that Welsbach must have known this. He could not account for his not mentioning erbia, if that was one of the class of bodies he wished to include. If erbia were substituted for yttria in the proportions mentioned in the specification, he believed the result would give an almost pure white light, though he could not speak with certainty, as he had never made the experiment. Referring to his answer in cross-examination, that he should take the sample of orthite as given in the analysis in preference to the sample of cerite, he said it would be because the directions were to take an earth containing no didymium and a small quantity of cerium. If it contained no lanthanum, it would not be suitable for the patentee's purpose. Cerite earth was given as a substitute for thorium. He should not think it right, in following the directions, to take a cerite earth which had the yttria group in it.

By Mr. MOULTON: Basic nitrates—a great number of them—were insoluble; but the ordinary or normal nitrates were soluble.

Mr. BOUSFIELD here announced that Mr. Sheldrake had searched for the letter previously referred to, and found it was never copied. If his Lordship wished, they would wire to Paris to procure it. They had the answers.

Justice WILLS said it would be desirable to get it if possible; and then he should know whether he ought to make any use of it or not.

Mr. BOUSFIELD said the purport of the letter was, in short, to exclude the use of thorium in making the mantles sent for.

Dr. *Auguste Duprè*, examined by Mr. WALLACE, said he had read the specifications in this case, and tried experiments and seen them tried. At the date of the patent, the state of public knowledge was that most of these rare earths, when strongly heated, became highly incandescent; and use had been made of this fact in various ways. He found in the specification a direction to use a compound—not single substances. The result to be produced was a full white light; and the substance was not to become volatile, to produce no scale, and last for many hours. The proportions given—60, 20, and 20—were of the oxides. Nothing was mentioned in the specification as to the strength of the solution. When it said the proportions were to be varied within certain limits, he thought it would mean varying each oxide a quarter either way; but not to leave out one of the substances altogether. It would not be fair to leave out one and put another in its place, except as was actually suggested. The compounds suggested were, first, zirconium, lanthanum, and yttrium, with the substitution of ytterite earth for yttrium, and cerite earth for lanthanum. It was very difficult to understand what was meant by ytterite earth; there was no such thing as ytterite earth. He assumed the patentee meant an earth allied to yttria or that could be obtained in the ordinary manufacture of yttrium. With regard to cerite earths, he (witness) thought at first it meant the natural mineral cerite; but it would be obviously not possible to use this. Then he came to the conclusion that earths found in cerite were meant—cerium, lanthanum, and didymium—of course, excluding the didymium. But how this was done, he could not say. Witness had tried experiments with regard to ammonia gas in conjunction with Dr. Hehner; and Dr. Hehner had also made some independently. They found that, except in the cases where they took Mirck's nitrate of zirconium, all the mantles that were ammoniated fell to pieces, though they could make a perfect mantle without ammonia. There was one exception. In trying to account for the mantles falling to pieces, they first of all analyzed the nitrate of zirconia, and found that it contained a quantity of nitrate of potassium. Then, thinking this might be the reason, they added the same or a larger quantity of potassium nitrate to Mirck's nitrate of zirconia; and it made no difference at all—they produced a mantle just as well as before. They therefore came to the conclusion that it was not the nitrate of potassium. He could give no idea why Mirck's should work, and the other should not. He had not analyzed Mirck's mantles, but Dr. Hehner had. He had tried to see if a better result would be obtained by altering the temperature—making two mantles of the same material and ammoniating them. He burned one with an ordinary flame; and it fell to pieces. He then tried the other one—using a very intense flame; and it gave a very good mantle. There was no direction in the specification as to the use of such an intense flame.

Cross-examined: He had no time to attempt purifying the chemicals. M. Girarde and his assistant were present; and he told them his experience was that freshly-made nitrate of zirconium would not answer. Therefore, to be fair, they avoided making it freshly. He did test the zirconium, and found it contained nothing appreciable except nitrate of potassium, which he had satisfied himself was not the cause of failure. Experiments had been made the previous week and this week. He had not tried whether freshly made solutions would do. He was satisfied the impurity was nitrate of potassium. He had not attempted to remove it, because it was equivalent to making fresh nitrate. He had heard evidence that persons using the chemicals described had made hundreds of these mantles with ammonia, which stood. He had not seen one burnt off in Court. He had heard that it burned differently from the ordinary mantles. He thought he was entitled to say that this experiment did not succeed with ammonia, having tried it and proved that the only impurity present had no influence. The patentee did not tell them to take pure material. The assumption was that, if they substituted cerite earth and ytterite earth, they might use impure materials. The potassium salts would become carbonates in the ignition. He did not suggest that Mirck's zirconium was not pure. He had made no magnesia mantles; but he did not doubt Dr. Hehner's statement that when so made they had never failed. The variation of the mixtures used would not affect the applicability of the method. The probability was that all these rare earths would give strong incandescence at high temperature; but it was not that there were great variations of the intensity. The whole of these earth oxides, after they were separated as oxides, would be soluble, though there would be differences in solubility. It was known as the general character of these earths that at a high temperature they would give a strong incandescence—that heat applied to nitrates reduced them to oxides; but that heat did not reduce the oxides.

Re-examined: This was known also in reference to lime, magnesia, and alumina. These three were some of the best known of the incandescent earths. It was not known that all the separate earths which might be included in the ytterite group would give useful results for incandescent purposes. There was no suggestion in the specification that the separate substances referred to could be usefully employed for the purpose of incandescence; nor was there any suggestion that the lanthanum or its equivalent might be left out. It was not usual in manufacturing processes to use purified chemicals. If a specification directed the use of caustic potash, an experimenter would not suppose that chemically pure caustic potash was intended, but the ordinary commercial caustic potash, which would contain traces of alumina and sodium. There was nothing in the specification to lead one to suppose that the ordinary commercial impurities would be prejudicial to the process. He had found no other impurities in the chemicals he had used than the nitrate of potash, in any appreciable quantity. Zirconia was known many years before 1885. It could be procured commercially in 1884. With the sample of zirconia obtained from Mirck's, he succeeded in getting a mantle that held together when it was burned; but when he tried to move it over an incandescent burner, it fell to pieces. Witness repeated his evidence as to adding nitrate of potash to Mirck's solution, and being equally successful.

By Justice WILLS: Zirconia had been proposed thirty years ago in the place of limelight. It gave a much better light. He saw the light thirty years ago.

By Mr. MOULTON: It was used in small halls. He could not say whether the price was about £5 an ounce. He believed it was used to a great extent in Paris, but very slightly in this country.

By His LORDSHIP: As far as he knew, this was the only use which had been made of it.

By Mr. BOUSFIELD: If they could get the oxide commercially, there would be no difficulty in preparing the nitrate.

Professor *Vivian B. Lewes* was the next witness. After stating his qualifications, &c., he said he had Welsbach mantles submitted to him for photometric tests first at the end of 1887 or the beginning of 1888. They varied a good deal; but the average was about 6 candles per cubic foot of gas per hour. As now supplied to the public, they claimed 12½ candles, which was very moderate. He had seen them as high as 17 candles. It was this improvement in the mantle which, in his opinion, had had a great deal to do with their practical success. In 1885, when this patent came out, every chemist knew that certain of these rare earths, when heated to a given temperature, became incandescent, and gave a large amount of light. It was also well known that, if it was required to make a coherent mass of the oxides of these rare metals, there must be present some soluble salt, which, by its decomposition, would lute the particles together; and it had further been shown by Talbot that blotting-paper covered with calcic chloride would on being heated give a mesh-work of oxides in so fine a state of division as to be capable of becoming highly incandescent. This was important, as putting forward a principle which was afterwards used in the Welsbach burner. Frankenstein gave the idea of a hood or mantle made of fibrous tissue—an absorbent material. Stokes-Williams did exactly the same; and he also gave (in certain passages, not very coherent certainly) the idea of soaking tissue in a salt and burning it off. It was known in 1885 that certain oxides incandesced—lime, magnesia, and alumina, for instance. There was no knowledge at that time which would enable a person with this specification before him to say that a single substance could be substituted for the compound there mentioned, or that lanthanum (or the equivalent mentioned for it) could be dispensed with. The exact wording of the specification would have had to be followed. Witness received three De Mare fringes for analysis on May 25, 1895. On burning them off, he found what was left behind consisted of 56·56 per cent. of zirconia; 37·88 per cent. of erbia; and 6·06 per cent. of magnesia. He tested spectroscopically, and got the absorption bands of erbium—feeble, but perfectly distinct. He made no attempt to separate the erbia from any other constituents of the yttria group which might have been there. It would have been impossible. Assuming that ytterite earth might be substituted for yttrium, it would not follow, from any knowledge then existing, that any of the separate ytterite earths could be substituted for yttrium with similar results. The same answer applied to cerite earth, and any of its separate constituents.

Cross-examined by Mr. TERRELL: The analysis spoken to was the only one he had made of the defendants' fringes. In the quantitative analysis, he dealt with about half a fringe. The total weight after ignition was 33 milligrammes. He used a considerable portion of another one in trying to detect bismuth in it; but there was none. The question put to him was, Did the fringes substantially contain zirconium and yttrium, or zirconium, erbium, magnesium, and bismuth? He knew that erbia was distinguished from yttria by the absorption bands; and also that erbia was always found allied with yttria. He only had 12½ milligrammes of erbia; and the only possible way of separating erbium and yttrium would be by a long fractional precipitation, which would be impossible with such a small quantity. Wherever there was erbia, there would be small traces of yttria. The fringes were given him by Mr. De Mare in Paris, in the presence of Mr. Sheldrake. He knew that yttria was mentioned in Welsbach's specification, and was aware that erbia was not. He did not know that he had read the specification at the time. It never crossed his mind that it was important to discover whether or not there was yttria present in the alleged infringement. It was impossible by any known means to separate a possible 2 per cent. of yttrium from 12½ milligrammes of erbium. This was the first occasion he had tried the absorption band of erbia; but he had worked with other absorption bands before. The 12½ milligrammes were dissolved in 5 c.c. of water; and he had about 2½ inches of fluid. It was a 2½ per cent. solution, and showed slight but distinct absorption bands. If there had been a substantial quantity of erbia present, the bands would have been very marked.

By his LORDSHIP: He did not think any quantity of these fringes could have been obtained, even in Paris. As far as he knew, they were not made as a commercial article.

Cross-examination continued: Mr. De Mare had with him a French gentleman, whom he introduced as his Chemist; but he could not say whether his name was Franchet. No fluid was given him. The three fringes were enough to enable the presence of erbia to be detected. If he had had a dozen he should not have attempted the separation of erbia and yttria. However much he had had, he would not have undertaken such a laborious piece of work. Erbia gave a green spectrum, he believed. He had never seen it. He believed the green bands were given at a temperature far higher than that of a bunsen flame. Till the metal began to volatilize, the spectrum would probably be continuous even of erbium. In 1885, the greater number of the rare earths were known; but they had always been a "floating population"—here to-day and gone to-morrow. He could not say if it was well known that all these oxides gave soluble nitrates; but *à priori* he should say all metals gave normal soluble nitrates. It was also known that these nitrates were unstable at a high temperature; and that when decomposed, they left a residue of oxide which was coherent. Clamond took advantage of this fact. He (witness) had heard of a structure being given to an oxide by causing it to enter the tissue of a filament before Welsbach. He referred to Talbot's experiment. The greatness of Talbot's discovery did not depend upon the size of the thing he made, but upon the prominence given to the fact. It was published in the "Philosophical Magazine," and so got into the hands of nearly every chemist; and from there it was copied into "Gmelin," which was the text-book in every laboratory. He saw it there long before the date of this patent. Unfortunately, it did not suggest to his mind what it did to Welsbach. He did not think Talbot had a coherent oxide to any considerable extent. He had never seen it in operation.

Re-examined: He got 12½ milligrammes of metal of the yttrium group in a 2½ per cent. solution—a dilute solution; and this gave the erbia absorption bands, and enabled him to say that the main constituent was undoubtedly erbia, though there might be other members of the yttria group present. It was not known in 1885 that the rare earths, other than those mentioned in the specification, were more useful for the purpose of incandescence than lime, magnesia, or alumina; or that any of the yttrium metals mentioned in "Watts" would be more suitable for the purpose of an incandescent mantle than lime or magnesia. He was not even now prepared to say what coloured light would be given by the various metals; but he gathered from Welsbach's 1886 patent specification that erbium would give a green light. Nothing was said about an extra high temperature being required. He should say probably different compounds would have different degrees of coherences when formed into mantles; and there were undoubtedly differences in the illuminating power of the various rare earths. There was no common knowledge in 1885 which would enable anyone to say without experiment that any of the yttria earths not specifically mentioned would remain efficient without deterioration when exposed to the air. The Clamond burner was made practicable by the addition of acetate of magnesia—a soluble salt, which made the mass coherent. The Clamond lamp was exhibited at the Crystal Palace, and in several shop windows in London.

Some further experiments were next tried by Professor Swinburne, on the burning of mantles which were first treated with ammonia.

Professor *Swinburne* then gave the following evidence with regard to the experiment. He had taken the solution which was handed to the defendants, and soaked several mantles—some belonging to plaintiffs, and some to the defendants. He then burned off, after treating with ammonia, two belonging to the plaintiffs and one of the defendants'. The results were perfectly coherent, though they were too small to put on the plaintiffs' burner to try them. The solution he had handed back to the defendants.

Cross-examined: These mantles were not so coherent as those now manufactured by the plaintiff Company. He could not say for certina whether they would stand dipping in collodion. The amount of coherence did, in fact, very much depend on the precise solution used.

Re-examined: The solution must be of a reasonable strength. This one was obviously weak; it was a 10 per cent. solution, to imitate as nearly as possible what Dr. Hehner did. In ordinary work, he should use from 12 to 16 per cent.

Mr. BOUSFIELD drew attention to the character of the light given by one of the mantles.

Mr. TERRELL observed that the burner was not of suitable size for it.

Justice WILLS said he had no doubt the present process had been vastly improved. Professor Lewes had said they had got from 6 to 15 or even 17 candles, which was exactly what he should expect in a thing of this kind.

Mr. *David Wm. Sugg* was next called by Mr. BOUSFIELD. He said he was formerly a member of the firm of Sugg and Co. In about May, 1886, Mr. Welsbach came to England for the purpose of disposing of his invention; and he showed witness some of his mantles. He met him at Mr. Bellis's offices in St. Mary Axe. The mantles he had just seen burned in Court seemed stronger and harder than those he saw then. The candle power was 5·25 per cubic foot of gas. They were tested at Westminster. He reported against taking up the business. The mantle was not at all practicable as a commercial article. It fell to pieces at the slightest provocation; and it lasted but a short time. It did not compare favourably with the regenerative burners then in the market. Some further experiments were tried subsequently with the mantle, in the presence of Mr. Williams, who was connected with Mr. Bellis in the promotion of the Company. They then got a higher duty for it—nearly 30 candles for a consumption of 4 cubic feet of gas. He did not know what alterations were made in the chemicals; nor was he present at the experiments. He merely heard of them. The conclusion he came to at that time was that the light was not at all practicable.

Cross-examined: He was connected with the Sunlight Company—not as Director, but as Manager; and he was one of the defendants to the action brought by the present plaintiffs against that Company. He was induced to go into the business in February last year; and he considered the invention as now perfected a very great advance in gas lighting, and different from what had ever been done before. He was not prepared to say this of the invention as he saw it in 1885. He saw Mr. Welsbach in Mr. Bellis's office, when he brought three or four little bottles containing fluid. He had two or three bottles which altered the tone of the light; he said he could make it a yellow or a rose tint, if desired. But the candle power dropped considerably when the tint was added to it.

Thursday, March 19.

When the Court sat this morning,

Mr. MOULTON asked leave to mention the next case—that by the same plaintiffs against the Sunlight Company. He suggested that it should not be tried until after judgment had been given in the present action.

Mr. BOUSFIELD did not take the same view.

Justice WILLS said he had been thinking about this; and it appeared to him that the second case would be materially shortened by judgment being given in this case. He intimated, therefore, that he should not delay giving judgment when the evidence and arguments were concluded.

Mr. BOUSFIELD remarked that he should be quite prepared to take the evidence given in this case as evidence in the next — leaving out certain portions which would be irrelevant, and besides that the additional evidence would be very short.

After some further discussion,

His LORDSHIP said he would take home the pleadings in the next case that evening; and after considering them, he would give his decision, as the parties did not agree.

Mr. *D. W. Sugg* was then re-called, and further cross-examined by Mr. TERRELL: At the time he examined the mantles, Mr. Welsbach showed him, they were burned off in a different manner to that now followed. The mantles made by the plaintiffs in 1895 were much stronger; but he did not consider them as strong as those made by the Sunlight Company. An affidavit made by witness in March, 1895, was put to him; and he adhered to the statement therein contained. It did not occur to him that it was necessary to draw the distinction between the mantles shown him in 1886 and those made subsequently.

Mr. BOUSFIELD here produced the letter from Mr. Sheldrake to a

Director of the French Company asking for fringes made according to the original formula, and warning him against the presence of thorium.

Mr. *Sheldrake* (recalled) said he understood at the time he wrote the letter that the Héliogène Company were making mantles in which thorium was present. He produced a draft of De Mare's 1895 specification.

Mr. TERRELL objected to this being put in; but

His LORDSHIP said it had better be admitted.

Mr. BOUSFIELD said he had now to state what had been done with the solutions furnished by the plaintiffs. They were examined, and found to be practically pure; but there was a trace of magnesia, which he was not prepared to say affected the result. Mantles were then made which, after treating with ammonia, were coherent; and the same was the case when 10 per cent. of nitrate of potassium was used. Experiments were next tried with mantles made from Hähn's materials, purified; but again the mantles fell to pieces. He could only suggest that the zirconium supplied by the plaintiffs contained some other substance—some "moultonium" or other—which had not yet been separated, and which secured the good result. Perhaps zirconium, like didymium, was a twin metal, which would be discovered by further research.

Dr. *Hehner* (re-called) stated that he examined the solution supplied him, which he ascertained to be a 10 per cent. solution of zirconium and lanthanum. He used both plaintiffs' and defendants' fabrics. He narrated, in detail, the method of making the experiments which, with one exception, were made in conjunction with Dr. Dupré. He afterwards added 10 per cent. of potassium nitrate to the plaintiffs' solution, and made mantles and burned them. They were equally successful. The experiment was repeated with 20 per cent. nitrate of potassium, with the same result. He analyzed the lanthanum supplied by the plaintiffs, and found slight traces of alumina, cerium, and zirconium. The zirconium also contained slight traces of magnesia. They then took a 20 per cent. solution, and made successful mantles. Experiments were then repeated with Hähn's zirconia, with the same result as before—failure on ignition, even after the potassium nitrate had been removed. This occurred both with 30 per cent. and 20 per cent. solution. With a 10 per cent. solution, the mantles did not fall to pieces, but burned into holes. He had no theory to offer which would account for the different behaviour of the mantles.

Cross-examined: He took pains not to use undue pressure.

Mr. MOULTON said the plaintiffs' experts would take some of the salt, as obtained from Hähn, purify it themselves, and see what the result was.

Dr. *Dupré* stated, shortly, that he entirely concurred in the account Dr. Hehner had given of the last experiments.

Mr. BOUSFIELD said that was the defendants' case; and he must now proceed to sum it up. He complained that the case on the part of the plaintiffs had been changed since it was opened. They had put in De Mare's patents, and sought to raise a fresh case upon them. The first patent of 1894 was for a form of burner; and it was in connection with this that the claim to use any suitable solution must be read. The second patent of 1894 had reference to a process of mixing collodion with the raw oxides; and the third patent—that of 1895—claimed the special form of flat-flame bunsen burner which could be turned low without firing-back, and the use of a radiant feather or tissue of the form described, supported horizontally over the flame. The words about "any solution" were evidently put in to show that the invention had no reference to the solution, but to the form of apparatus. The defendants bought the patent, which did not claim any solution; and if any solution in particular infringed anyone else's patent, they had simply to use some other solution. That was the only meaning of the words which were now sought to be made use of to show that the defendants threatened to infringe the plaintiffs' patent. This was made, if possible, more clear by the affidavits, which showed throughout the absolute fairness and candour with which the defendants had acted. The only analysis of the defendants' fringes given by the plaintiffs was that of Mr. Ballantyne, who said he found zirconium, something belonging to the ytterite group, and magnesia. There was very little difference between the plaintiffs' and defendants' analyses; the principal point being that the latter spoke positively to the presence of erbia. The defendants obtained their erbia from Hähn's, of Hanover, and said it was essentially erbia with impurities. The plaintiffs asserted that it was essentially the ytterite group, containing a mere trace of erbia. Welsbach's claim to ytterite earth, or yttria-yielding earth, did not entitle him to claim every material which could be discovered in such earth—especially when the ytterite was only mentioned as an equivalent, and especially also when erbia (which must have been known to Welsbach) was not named. It was after all, he submitted, mainly a question of the construction of the specification, on which he had already addressed the Court and cited authorities. The spirit of the patent law was against the view that any man could shut up a whole field of industry by patenting a principle, which was really what the plaintiffs were seeking. They had had the reward of their researches, for they were very successful, and appeared to have plenty of money. But he submitted that they were not entitled to prevent other inventors working in the same direction, so long as they examined the plaintiffs' specification, and took care to avoid what had been claimed. The specification was for a cap or hood; but he (the learned Counsel) did not lay so much stress on those words as on the word "fabric," which he contended could not include a thread, especially as, in a subsequent patent, Welsbach said that "instead of a fabric a number of separate threads hung from a platinum wire," might be used. He would reserve any further comments on the question of the use of ammonia until it was seen whether any further evidence was given with regard to it; but it was quite clear that ammonia did more harm than good.

Mr. MOULTON, in his reply, said he should not have to go over the subject so fully as in opening, because his Lordship had been so thoroughly informed on the whole of the scientific details by the evidence which had been given. This evidence, he submitted, had fully supported his opening statements. There was no doubt that this was the first successful attempt at incandescent gas lighting; and he hoped that both Stokes-Williams and Frankenstein were now thoroughly dead and buried.

Justice WILLS said he need not trouble Mr. Moulton to address him on the question of the novelty of the patent, or—subject to anything further which might be proved about the ammonia—its utility.

Mr. MOULTON said it was not disputed that—among the thousands of incandescent burners now in use—there was not one which was not made by the process disclosed in Welsbach's specification. They had therefore established the great merit and the revolutionary character of this invention. The first question with regard to infringement was that of fact; and in that respect this case was almost unique. The defendants tried to minimize what they could be accused of, while proclaiming as boldly as possible to the public what they were going to do. For this purpose, he referred to the answers to interrogatories, which he said amounted to a plain threat to infringe the plaintiffs' patent. There were two sets of plumes manufactured in the way the defendants said they intended to manufacture them; and the question of infringement must be decided by an examination of these plumes or fringes. He (Mr. Moulton) then read from the affidavit and cross-examination of Mr. Franchet, as showing that the solution used consisted of 55 per cent. zirconium and 40 per cent. of impure erbium, which the witness had not analyzed. Some of the solution had been shown to have been sent to Mr. Sheldrake. But his friend refused to produce it; and no analysis of it had been given. The plaintiffs had done their best by analyzing the fringes themselves; and Mr. Ballantyne's evidence showed the result. He failed to find any trace of erbium, and concluded that the substances other than zirconia were some of the yttria group. Professor Lewes gave an analysis showing 36 per cent. of erbium; but he admitted that he had never before experimented on erbium, which was the only excuse for the amazing statement he made. Dr. Hehner only said he got something in which erbium was present. He (Mr. Moulton) therefore asked his Lordship to come to the conclusion that Mr. Ballantyne's was the most reliable analysis; and that besides the zirconia the rest of the substance belonged to the yttria group, which he submitted was an infringement of the patent. Mr. Moulton then went at some length into the question of the construction of the specification as affecting the scope of it, and what would be an infringement. The method of an infringer was, he said, always to carefully scrutinize the specification, and take the substance of it, while denying that he took it in form. It had been held again and again that where the substance of the invention was taken, there was infringement, even if the precise words had been evaded. The real question here was resolved into what was the invention, as claimed, and having regard to existing knowledge. The invention, he maintained, was the method of obtaining a frail but coherent skeleton of these resistant earths which would give practical means of obtaining light by incandescence.

After luncheon, Mr. MOULTON said he must admit, in justice to Dr. Hehner, that the specimen of Hähn's chemicals which had been handed to the plaintiffs had beaten them. Mr. Clerk found he could not make a successful mantle with it, using ammonia. What the reason was, he could not say. He then continued his argument, illustrating it by Edison's telephone patent, for the combination of a diaphragm and a tension regulator. In this case, he said, many widely differing things, not mentioned in the specification, were held to come within it. The lanoline patent was decided on somewhat similar lines. He then referred to the case of *Curtis v. Platt* (3 Ch. Div.), where the patent was not held to be infringed, because the result obtained was not new; and therefore the patentee could only claim the particular method he had invented. Other cases were referred to, in support of the principle for which he was contending—that the question was whether the substance of the invention had been taken. This depended, to a great extent, on the magnitude of the step taken by the patentee, as compared with previous knowledge. He then proceeded to develop, at some length, what he had previously suggested as to the step which was taken by Welsbach in making this invention. The great point was the use of nitrates of the oxides of the rare metals, which had been discussed in such detail by the scientific witnesses. This was the pith and marrow, to use Lord Cairn's phrase, of the invention. All these oxides belonged to the same class, and had the same physical qualities as applicable to the purpose intended; and they were therefore all within the specification. His interpretation of the phrases "ytterite earth" and "cerite earth" was that two classes of earths were contrasted, one in which the ytterite group predominated, and the other in which the cerite sub-group predominated—of which cerite and orthite might be taken as examples of one class, and gadolinite of the other. In any case, it must be a blend of things which would make a coherent mantle. No one had suggested any possible reason for omitting lanthanum and using erbium; and the only conclusion to be drawn was that it was merely done with the idea of evading the exact words of the patent. He then went through the specification line by line, and commented upon it, to support the view that the substance of the invention was the method of working, which was absolutely new. The claim was for the manufacture of an illuminating appliance—not for the use of zirconium or lanthanum. The defendants had manufactured an illuminating appliance in the manner set forth in the patent and treated as described; and he (Mr. Moulton) contended that they were actually within the words of the claim. But what was of more importance, they had undoubtedly taken the substance of it. It was sometimes said that it was difficult to apply the doctrine of equivalents to chemical matters; but he submitted that this was not a question of chemicals but of physical characteristics. With regard to the form adopted by the defendants, he submitted that it was a perfectly immaterial difference; and that it really was a fabric. But even if that were not so, they would have equally infringed the substance of the invention. He did not think it necessary to deal at any length with the cases cited by his learned friend; and he submitted, on the whole, that the plaintiffs were entitled to succeed.

Mr. BOUSFIELD asked permission to say a word or two on the cases cited by Mr. Moulton, which he did shortly, as to one or two; and he asked leave to occupy a few minutes on the others next morning.

His LORDSHIP announced that the case against the Sunlight Company would be commenced on Monday [yesterday], but owing to his other engagements, would not be continued until the following Friday, when it would go on until it was concluded. The evidence taken in the present case would be treated as given in the other case also.

Friday, March 20.

On the resumption of the proceedings this morning,

Mr. *Ballantyne* was recalled. He said that on the previous evening he took the Hähn oxide of zirconium, and, after carefully purifying it by the ordinary method (which he described in detail), he dissolved it in weak nitric acid, and made two mantles with a mixture of that solution, and the same oxide of lanthanum as had been used previously. The mantles were ammoniated, and proved quite coherent. They were then dipped in collodion; and he produced them.

Mr. BOUSFIELD said he was not in a position to put any questions to the witness; but he should like to try some further experiments.

Justice WILLS said he should not object to that, and

Mr. BOUSFIELD intimated that he would deal with the matter, if necessary, at the opening of the next case.

It was arranged that another sample of the Hähn oxide, sufficient for analysis, should be handed to Professor Dewar, and that the rest should remain in Court.

Mr. BOUSFIELD added a few comments on some of the cases cited by Mr. Moulton.

The proceedings were then adjourned until Monday, in case any further evidence was forthcoming with regard to the Hähn oxide of zirconium. It is understood that judgment will not be given until the next action (against the Sunlight, &c., Gas-Lamp Company) has been tried.

The Depth of Water Service-Pipes.

At the Lambeth Police Court last Tuesday, Mr. Hopkins resumed the hearing of a summons taken out by the Camberwell Vestry against Mr. H. Gee, the owner of a house in Brief Street, Camberwell, for permitting the premises to be occupied as a dwelling-house without having first obtained the certificate of the sanitary authority to the effect that the premises had a proper and sufficient supply of water. Mr. Lowe appeared in support of the summons; and Mr. H. C. Gollan represented the defendant. When the case was previously before the Court, Mr. C. H. Kerslake, one of the Sanitary Inspectors in the service of the Vestry, said the defendant, as the owner of the premises, applied to him for a certificate; but he refused to grant one, because the connection between the Company's main and the house was only 11 inches below the surface of the ground. The regulation of the Vestry required that the connection should be 2 ft. 6 in. underground, so as to prevent the action of frost. The defendant now made an application under sub-section 3 of the 48th section of the Public Health Act, which empowers a Petty Sessional Court, if they think a certificate ought to have been granted, to make an order authorizing the occupation of the house. Mr. Lowe, in addressing the Court in support of the Vestry's case, pointed out that, under the Metropolis Water Act, 1871, and also the Metropolis Water Act, 1852, powers were given to the Board of Trade to make regulations with the view of preventing, in the words of the Act, "the undue consumption of water." These regulations were made by a minute of the Board in 1872; and No. 10 required that communication-pipes should be laid at least 2 ft. 6 in. below the surface. In the present case, the pipe at the point at which the stop-cock was fixed was only 11 inches down. The depth of the main was 2 ft. 1 in., so that it was clear that the communication-pipe might have been placed at a much greater depth. The Vestry, as a public body, desired that the supply of water should be sufficient not only for the moment, but for the whole year. A service which was liable to be affected by the frost was not a satisfactory service. A depth of 2 ft. 6 in. had been adopted as the minimum for water-pipes for safety; and, having regard to the regulations of the Board of Trade, he submitted that the Vestry had no other course open than to refuse a certificate in this case. Mr. Gollan pointed out that the summons was not taken out under the Board of Trade regulations. The Public Health Act provided that a house, under certain conditions, should not be occupied as a dwelling-house until the sanitary authority had certified that it had a good and sufficient supply of water; but the section did not say that the certificate was not to be given unless the Board of Trade regulations were complied with. The case was adjourned for a fortnight to enable the defendant to lower the pipe to as great a depth as that of the Company's main would allow.

A Question as to the Levying of a Lighting Rate.

Considerable interest has been raised lately in the village of Clown in connection with the lighting rate; certain of the residents having refused to pay it. In consequence, summonses were issued against Messrs. T. Earnshaw, W. Woodhead, and Mr. G. Roberts, who have accordingly appeared before Alderman Swallow and other Magistrates at the Eckington Petty Sessions. The Overseers were represented by Mr. W. E. Clegg, and the defendants by Mr. J. Middleton. At the outset, Mr. Clegg called Mr. W. Wilson, one of the Overseers of Clown, to prove that he had received authority, signed by the presiding Chairman and two members of the Parish Council, to raise a rate for lighting and watching; that he produced a rate-book, containing the names of the persons liable to be rated for the Parish of Clown, allowed by the Justices on Feb. 9, 1895; and that they were properly rated, and were occupiers. He admitted, in cross-examination, that there was considerable opposition to paying the rate. On being asked by Mr. Middleton whether he was present at the parish meeting, Mr. Clegg objected. Mr. Middleton, however, said he was going to argue the question. This was a rate under the Lighting Act of 1833, which was not the law of the land with regard to every parish. It did not apply to a parish unless it was adopted in that parish or town. Down to March 26 last year, the Act did not apply to Clown, but was then adopted; and he wished to see if it had been properly brought into force, for, if not, the rate could not hold good. The question was repeated; and witness stated that he did not attend the meeting until late in the proceedings. Questioned as to whether the rate was made in pursuance of an order to collect £140, he said he believed it was for £190. The object of the rate was really to raise £200. Mr. Middleton asserted that the rate was bad on the face of it, because any sum the Parish Council wanted for the purpose of lighting must be fixed by the parish meeting. The order was for £140; but the rate was to raise £215. The Local Government Act, section 32, provided that a Parish Council should issue an order on the Overseers for the amount that had been determined to be spent on lighting at the parish meeting; and there was a proviso that they must not raise more than the amount required. They had ordered £140, and they had also somewhere else a precept for £50; and these they had put together, and levied a rate for £200. That was not for lighting; and all they had to do was to levy for lighting. The rate provided for 6d. in the pound on property and 2d. on land. That was wrong, because it had been expressly held that the words in the Act must be taken literally. The words "three times greater than" must be taken literally. The rate on property was 6d. and the rate on land, he contended ought to be 1½d. He submitted that was one point on which the rate was bad. If the Bench considered they had nothing to do with this, he asked them to give him cases on both points raised. Mr. G. H. Calow, the Clerk of the Parish Council, said he did not know if there was a requisition signed by three inhabitants asking for the adoption of the Lighting Act, nor was he aware there was a meeting called to consider the question. The Parish Council were empowered, at the annual parish meeting on March 25, 1895, to levy a rate not exceeding 6d. in the pound, for the ensuing twelve months, to meet the demands of the Act. Mr. A. Eason, who was acting as Clerk at the time the parish meeting was called, said he did not receive a requisition from three ratepayers to call the meeting, nor did he give notice of the meeting on the principal church and chapel doors. Mr. Clegg, in his reply, submitted that, if the defendants objected to pay the rate, they should have done it in a proper way—viz., by an appeal to the Assessment Committee and Quarter Sessions. The Magistrates, he maintained, had nothing to do with the question as to whether the rate was properly or improperly made. After retiring, the Bench made an order for the rate to be paid forthwith. Notice of appeal was given.

Danbury Water Supply.—Major-General H. D. Crozier, R.E., held an official inquiry at Danbury, on behalf of the Local Government Board, last Wednesday, in respect of an application of the Chelmsford Rural District Council for permission to acquire land otherwise than by agreement, for the purpose of constructing water-works at Gay Bowers. The Clerk to the Council (Mr. W. W. Duffield) said it was proposed to connect the water-works at Buell, which were already in use, with the new works at Gay Bowers; the spring at that place being equal to yielding a supply of 30,000 gallons of water a day, while until lately the Buell spring yielded a daily average of 80,000 gallons. It now, however, only gave about 30,000 gallons. But the springs of the county never were so low as at present. They thought that if an agreement could not be come to with regard to the land, they should have power to submit the matter to arbitration. The Inspector said that only the parishes concerned in the proposed scheme would be called upon to contribute to the cost; and he would report to the Local Government Board after he had inspected the springs.

New Joint-Stock Companies.—The following Companies have lately been registered: Market Harborough Gas Company, Limited, with a capital of £30,000, in £25 shares, to acquire the undertaking of the Market Harborough Gaslight and Coke Company, Limited (constituted in 1833, and registered in 1856), and carry it on. Holyhead and North Wales Gas and Water Corporation, Limited, with a capital of £100,000, divided into 100,000 shares of £1 each, to carry on business as manufacturers and suppliers of coal gas, or other inflammable gas or artificial light; to establish works for the supply of water for public, domestic, and other purposes; and to construct gas-works, water-works, reservoirs, cisterns, dams, filter-beds, pumping-stations, aqueducts, &c. The Cottonwood Water Power and Electric Company, Limited, with a capital of £210,000, divided into 210,000 shares of £1 each, to carry on, in the territory of Utah, U.S.A., and elsewhere, the businesses of suppliers of power, water, and electricity, in all or any of their respective branches. The Petroleum Distributing Company, Limited, with a capital of £50,000, divided into 50,000 shares of £1 each, to acquire, by purchase or otherwise, any lands, oil wells, refineries, mines, buildings, machinery, plant, &c., and to carry on the purchase, supply, and distribution of petroleum and its products. The Schnodica Petroleum Company, Limited, with a capital of £5000, in £1 shares, to acquire, develop, and work lands, mines, oil wells, refineries, &c.

Sheppy Gas Company.—The annual general meeting of this Company was held on the 14th inst.—Mr. C. B. Shrubsole in the chair. In moving the adoption of the report, which was noticed in the "JOURNAL" for the 10th inst., the Chairman alluded to the gratifying increase in the consumption of gas in each of the three towns of Sheerness, where there had, he said, been a greater demand not only for business establishments, but for private dwellings, where gas was taking the place of oil. It was proposed to increase the storage at the works to the extent of 100,000 cubic feet, by telescoping the large gas-holder. The undertaking was in such a satisfactory position that full dividends for the past year could be paid, and leave a balance of £400 to be carried forward. The report was adopted; and the dividends recommended were declared. Mr. J. R. Brett proposed a vote of thanks to the Secretary (Mr. A. W. Marks) and the Engineer (Mr. W. T. Carpenter), for the excellent manner in which they had managed the business of the Company during the past year. The indefatigability and diligence displayed by both in everything they undertook must, he said, be a source of pleasure to the shareholders. The motion was unanimously agreed to. In responding, Mr. Marks thanked the shareholders for this renewed sign of their confidence. He had completed 34 years in the service of the Company—a tolerable slice out of the life of any man—and he hoped to be spared to serve them for several years to come. Mr. Carpenter said it had been his privilege to serve the Company as Engineer for 36 years. He had always tried to do his best in the past; and he could assure the shareholders that no effort would be wanting on his part in the future to make the Company a success. A vote of thanks was also accorded to the Chairman and Directors for their services during the year.

MISCELLANEOUS NEWS.

EDINBURGH AND LEITH GAS COMMISSION.

Carburetted Water Gas to be Introduced—Dr. Crum Brown's Report.

The Statutory Annual Meeting of the Edinburgh and Leith Gas Commission was held on Monday, the 16th inst.—Lord Provost M'Donald presiding. The Works Committee presented the subjoined report which they had received from Professor Crum Brown, of the Chair of Chemistry in the University of Edinburgh, on "Various Points Connected with the Preparation and Use of Carburetted Water Gas as an Illuminant."

The name "water gas" has been given to the gaseous mixture obtained by blowing steam over coke or charcoal at a high temperature. The steam—a compound of hydrogen and oxygen—is decomposed in the process; the oxygen being taken by the carbon to form carbonic oxide (carbon monoxide), and the hydrogen being left free. The carbonic oxide is not an immediate product, as carbonic anhydride carbon dioxide—a compound containing twice as much oxygen for the same amount of carbon) is first formed. In passing over more hot carbon, the carbonic anhydride is converted into carbonic oxide. If the action has been completely carried out, the resulting mixture consists of equal parts (by volume) of hydrogen and carbonic oxide. During the action the temperature falls if there is no external heating; and, in consequence, the carbonic anhydride is only partially converted into carbonic oxide. It, therefore, becomes necessary to raise the temperature again. This can be effected by blowing in air instead of steam, whereby a mixture of nitrogen and carbonic oxide, known as "producer gas" is obtained. Producer gas can be used as a fuel; and in the process of making water gas it is employed for heating various parts of the plant. We have, therefore, two alternating stages in the technical manufacture of water gas—the "blow," during which the temperature is raised sufficiently high by means of an air-blast; and the "run," during which water gas is produced by blowing steam over the glowing coke.

Both hydrogen and carbonic oxide are colourless, transparent, and odourless. They are combustible in air—forming respectively water and carbonic anhydride. Their flames are practically non-luminous, but are very hot. The *amount of heat given out* (not to be confounded with the temperature of the flame) is the same for equal volumes of the two gases, supposing the products to be cooled to the ordinary temperature; but under ordinary working conditions more of this is available in the case of carbonic oxide than in the case of hydrogen, as the carbonic anhydride carries away considerably less heat than the water vapour. As a fuel, carbonic oxide is more valuable than hydrogen.

While pure water gas is a good fuel, it is of no use as an illuminating agent. If, however, it is mixed with some gas or vapour rich in "heavy hydrocarbons" (compounds of carbon and hydrogen in which there is a relatively large proportion of carbon), a strongly illuminating flame can be obtained. "Oil gas" is very rich in these heavy hydrocarbons; and, therefore, a suitable mixture of water gas and oil gas makes a very good illuminating gas. Such a mixture is known as "carburetted water gas." In preparing carburetted water gas by modern methods, the oil gas is not made separately and then added to the water gas, but oil itself is sprayed into the hot crude water gas in a chamber called the carburettor. This oil is immediately vaporized; and being thereupon strongly heated in the "superheater" is decomposed ("cracked"), giving oil gas ready mixed with water gas. The crude carburetted water gas has to be purified from a small portion of tarry matter, from sulphur compounds, and from carbonic anhydride, in the same manner as crude coal gas. The crude gas, after passing through the scrubbers and condensers, enters into a small gasholder (the "relief holder"), from which it is drawn by exhausters to the purifiers. As the amount of carbonic anhydride to be removed depends on the temperature of the generator, the durations of blow and run have to be properly controlled.

It does not follow that the carburetted water gas thus obtained has the same quantitative composition as if the water gas and the oil gas were made separately, and then mixed. The constituents of the water gas may reasonably be expected to take part in the cracking of the oil vapours; so that, while we should look for the same ingredients in the two cases, we should not expect them in the same proportions.

Before considering the case of carburetted water gas in detail, it will be convenient to look at the composition of ordinary coal gas as presently supplied in Edinburgh. The following analyses were made on the 5th, 6th, 12th, and 19th of February, 1896, respectively. A and D were carried out on samples drawn from the main entering the east meter in New Street works; B and C were on samples drawn in the Chemistry Department of the University:—

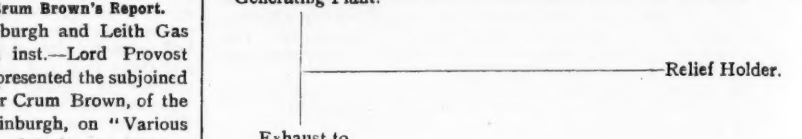
	A	B	C	D
Carbonic anhydride	0·2	0·1	0·2	0·3
Heavy hydrocarbons	9·2	8·6	8·9	8·8
Oxygen	0·2	0·0	0·0	0·1
Carbonic oxide	10·8	9·6	11·0	10·8
Methane (marsh gas)	37·1	35·9	34·8	35·5
Hydrogen	36·6	41·2	40·3	41·6
Nitrogen (by difference)	5·9	4·6	4·8	2·9

We may, therefore, say that Edinburgh gas at this time averages, in round numbers: Heavy hydrocarbons (illuminants), 9; carbonic oxide, 11; methane, 35; hydrogen, 40; and nitrogen, 5—all being expressed in percentages by volume.

For the purposes of this report, investigations were made into the process of manufacturing carburetted water gas as carried on at two separate works, which we shall call *A* and *B*.

Carburetted Water Gas as made at "A."

The results of the investigations made at *A* were unsatisfactory, for various reasons. In the first place, the process is being worked at present during only twelve hours out of the twenty-four. The town supply, which is a mixture of water gas with ordinary coal gas, is therefore of variable composition. In the second place, it is not possible to obtain a proper average sample of the purified carburetted water gas alone, owing to the fact that the relief holder between the producing and the purifying plants is provided with only one main, which serves both for inlet and outlet; and the relief holder is situated at a considerable distance from the other portions of the plant—



The production of water gas being intermittent (five minutes' blow and seven minutes' run), the exhausters are worked to pass in twelve minutes, at a regular average rate, the gas produced in seven minutes. The quantity of gas produced varies considerably at different stages of the run; being greatest at the commencement. If we accept the *data* of Mr. James Stelfox, C.E., of Belfast, then in a seven minutes' run producing altogether 9000 cubic feet, more than half comes off in the first three minutes; and the production during the first minute is three times that during the last minute. In that case, with arrangements as at *A*, it follows that, during less than six minutes of the run, gas passes into the relief holder; and during the remainder of the run, and the whole of the blow, gas is passing through the same main from the holder. The gas in the holder is, therefore, never representative of the average crude product. The gas passing into the purifiers is continually changing in composition, and mixing cannot take place in the purifiers, after which the gas mixes with the coal gas. Thus, a sample of average composition cannot be obtained at any part of the process; and proper control by means of chemical examination or photometric observation is not really possible. In a process of this kind, a proper chemical control is of importance, as the various conditions are easily adjustable so as to give desired results.

The points above noted are illustrated very markedly in the results of the analyses made. In fact, it was the excessive discrepancies observed which led to the details being inquired into.

The producing plant at *A* consists of only two chambers, a generator and a combined carburettor and superheater.

To obtain an idea of the average composition of the crude plain water gas, three samples were drawn from the top of the generator at one, four, and seven minutes respectively from the beginning of the run. The run was the last previous to recharging with coke. The samples were analyzed immediately, with the following results:—

	1 Min.	4 Min.	7 Min.
Carbonic anhydride	0·9	8·8	14·9
Oxygen	0·0	0·0	0·0
Carbonic oxide	47·1	34·2	25·4
Hydrogen	48·1	54·7	57·4
Nitrogen	3·9	2·3	2·3

There would probably be a small quantity of methane; but this was not determined, being unimportant at this stage. If any were present, then the figure for hydrogen, as given above, would be correspondingly too high.

These results show very clearly the rapid rise in the amount of carbonic anhydride, and corresponding fall in carbonic oxide, as the temperature of the coke in the generator falls. If they are at all typical, they indicate rather uneconomical working; the percentages of carbonic anhydride being unduly high. Possibly the fact that it was the last run before recharging may have something to do with it. The average for the whole run would be below the average of the above, as the amount produced is greatest at the commencement, when the amount of carbonic anhydride is least. Three per cent. of carbonic anhydride is said to be a good proportion to aim at in average working.

Samples of the purified carburetted gas were also collected and analyzed, with the results shown in the following table. A and B were taken from the top of the last purifier. C was drawn from the relief holder main, passing through an experimental purifier in the laboratory. These were analyzed immediately. D is similar to C, but was drawn later and was brought in a sealed tube to Edinburgh for analysis. Owing to the conditions previously mentioned, the results are not at all constant—

	A	B	C	D
Carbonic anhydride	0·2	0·2	0·3	0·2
Heavy hydrocarbons	12·6	13 6	11·9	11·0
Oxygen	0·0	0·0	0·0	0·0
Carbonic oxide	28·6	26·6	29·9	30·5
Methane	15·9	19·9	18·0	17·5
Hydrogen	35·4	33·5	34·9	35·7
Nitrogen	7·3	6·2	5·9	5·1

A sample of the crude carburetted gas direct from the relief holder main was brought to Edinburgh in a sealed tube, and gave the following results:—

Carbonic anhydride	4·2
Heavy hydrocarbons	10·5
Oxygen	0·0
Carbonic oxide	32·8
Methane	16·5
Hydrogen	32·2
Nitrogen	2·8

A determination of carbonic anhydride in another sample similar to the latter, but drawn at a different time, gave (on being analyzed immediately) 10·8 per cent. This also exemplifies the great variation of the composition of the gas in the main.

Two samples of the town supply were also brought to Edinburgh in sealed tubes. They were drawn from an ordinary bracket tap in the laboratory, with a fair interval of time between. Results—

Carbonic anhydride	1·0	1·0
Heavy hydrocarbons	6·8	6·8
Oxygen	0·5	0·6
Carbonic oxide	10·6	11·9
Methane	33·7	32·2
Hydrogen	42·9	42·3
Nitrogen	4·5	5·2

Apparently these samples consisted principally of common coal gas; the quantity of admixed carburetted water gas being somewhat higher in the second, which was the later drawn.

On averaging the results of all the analyses made, the purified carburetted water gas at *A* appears to contain, in round numbers: Heavy hydrocarbons, 12 per cent.; carbonic oxide, 30; methane, 18; hydrogen, 35; and nitrogen, 5.

As regards illuminating power, little can be said. Time being limited, no readings were specially taken, as the analyses showed that considerable fluctuations were to be expected. The town supply was said to be about 21 candles, however, and the carburetted water gas 25 to 26 candles.

Carburetted Water Gas as made at "B."

In these works, nothing else is made. The unmixed gas is stored in large quantity, and is supplied to the surrounding districts pure. The balance is used to mix in varying quantity with coal gas made at other works. The coal gas being supplied at 21 candles, the carburetted water gas is made of the same value, so as to give a uniform illuminating power throughout the whole of the district.

The producing plant at *B* consists of three distinct chambers—generator, carburettor, and superheater; but the principle is the same as at *A*. The blow lasts only four minutes, and the run is seven minutes.

As at *A*, three samples were drawn from the top of the generator at the end of the first, fourth, and seventh minutes of the run. These were analyzed immediately; the results being given in the following table. The run was about half-way between chargings—

	1 Min.	4 Min.	7 Min.
Carbonic anhydride	0·8	4·7	12·1
Oxygen	0·0	0·0	0·0
Carbonic oxide	48·2	40·6	29·9
Hydrogen	48·6	52·7	56·1
Nitrogen	2·4	2·0	1·9

It will be noticed that these results show a more satisfactory proportion of carbonic anhydride than those obtained at *A*. The rapid change in composition attending fall of temperature is also very marked here.

A sample of the crude carburetted water gas drawn just before it enters the purifiers gave at that time 4·7 per cent. of carbonic anhydride. A similar sample, taken in a glass tube and sealed, gave on analysis in Edinburgh—

Carbonic anhydride	4·1
Heavy hydrocarbons	11·8
Oxygen	0·0
Carbonic oxide	30·1
Methane	20·7
Hydrogen	28·7
Nitrogen	4·6

The relative amounts of the various constituents as shown above agree very well with those obtained for the finished product; so that the sample was evidently a fair average one. The amount of carbonic anhydride was considered by the officials to be above what was proper for normal working, 3 to 3½ per cent. being what was aimed at.

The samples of the finished product taken for analysis were drawn from a tap in the governor-house, and were therefore part of the ordinary supply as it left the works—coming from a large storage gasholder. They may consequently be taken as fair average samples. *A* was drawn about 1.30 in the afternoon, when the temperature of the air was exceptionally high for the season of the year. It was analyzed immediately. The candle power, determined at the same time, was 23 to 24 candles—being 2 to 3 candles above the usual working value. *B* was drawn in the evening, when the temperature was considerably lower, the candle power then coming out normal at 21 candles. This sample was carried to Edinburgh in a copper cylinder provided with good taps. Results—

	A	*B*
Carbonic anhydride	0·0	0·2
Heavy hydrocarbons	12·3	11·7
Oxygen	0·0	0·1
Carbonic oxide	32·0	32·1
Methane	21·2	21·2
Hydrogen	28·2	28·8
Nitrogen	6·3	5·9

The samples thus differ markedly only in the proportion of heavy hydrocarbons, as was to be expected. The sample which corresponded to 23·5 candles is distinctly richer than the other.

The values thus obtained differ considerably from those (already noted) which were subsequently obtained at *A*, and were rather unexpected. The most striking points are the relatively high percentage of methane, and the low percentage of hydrogen. The proportion of hydrogen is considerably lower than that of carbonic oxide, although in the crude uncarburetted gas it is considerably higher. This shows conclusively that the constituents of the water gas act chemically during the cracking of the oil vapours—part of the hydrogen going to form methane with some of the constituents of the vapours.

Such a difference between the composition of *A* gas and that of *B* gas might arise from different oils being used; but in each case "solar distillate" is said to be the material worked with. It is, therefore, probably due either to the difference in plant, or to variations in the working conditions as regards the temperature of the various chambers, &c.

In round numbers the composition of *B* carburetted water gas may be taken as: Heavy hydrocarbons, 12 per cent.; carbonic oxide, 32; methane, 21; hydrogen, 29; nitrogen, 6.

Similar gas, but of 25 to 26 candle power, would differ chiefly in having a higher percentage of heavy hydrocarbons—say, about 13; but in such a matter it is impossible to calculate accurately beforehand. In the case of a very rich carburetted water gas to be used for enriching a poorer coal gas, it would be still more difficult to state beforehand the probable composition. It would be chiefly the proportion of hydrocarbons which would be affected; the others being lower correspondingly. The amount of carbonic oxide would be affected least of all.

For purposes of calculation, we may assume 25-candle carburetted water gas, prepared as at *B*, to have approximately the following composition: Heavy hydrocarbons, 13 per cent.; carbonic oxide, 32; methane, 21; hydrogen, 28; nitrogen, 6.

A mixture of such gas with Edinburgh coal gas, of the composition stated above, would therefore contain, if mixed in the ratio 1 : 2, about the following proportions: Heavy hydrocarbons, 10 to 10·5 per cent.; carbonic oxide, 18; methane, 30; hydrogen, 36; nitrogen, 5.

It will be noticed that the proportion of heavy hydrocarbons is considerably less in coal gas than in carburetted water gas of similar illuminating power. In the former case, however, they contain a larger proportion of carbon, and are therefore more efficient volume for volume.

With the above data, we can now form an opinion as to the various points on which information was specially asked. The first of these is the degree of risk of poisoning incurred by the public by the use of carburetted water gas, as against ordinary coal gas.

In the case of coal gas, the great safeguard against poisoning is the powerful odour of the gas; and, as a rule, accidents happen only where people are totally unaccustomed to the use of the gas, and go to sleep with the tap in the room left open and the light blown out, or where there is a large escape due to leakage subsequent to falling asleep. Were it not for the characteristic smell, coal gas itself would be a very dangerous substance to have led in pipes all over dwelling-houses. The smell is chiefly due to the small quantity of benzene vapour present in the gas. Benzene vapour is present in carburetted water gas also, and to as great an extent as in coal gas. We should, therefore, expect carburetted water gas to have a similar smell; and such is the case. At *B* this point was specially noted. The officials there said they considered the smell decidedly more "pungent" than that of coal gas; but there did not seem to be much difference when it was observed while the gas was issuing direct from a jet over which the nose was held. The very unpleasant character of the smell came out, however, in an experiment which was tried, in which gas was allowed to escape into a room. This room measured fully 20 feet by 11 feet, and was 15 feet in height. Its capacity was therefore about 3300 cubic feet. There were two windows and a glazed door communicating with the outside; and the door ordinarily used communicated with another room. Gas was allowed to escape from a common jet on a bracket at the side of the room. The burner was nominally a 4-feet one; but as the pressure was above normal, we may assume that it passed 5 feet in the hour, at the outside. In 2 to 2½ minutes, there was a quite distinct smell of gas in the centre of the room. This was much more marked near the windows, and very marked on standing on a chair in the middle of the room so as to get above the level of the gas-bracket. The jet was 6 feet above the level of the floor. In five minutes the smell was so strong in the middle of the room that it was decidedly unpleasant. In this time less than 5-12ths cubic foot of gas had escaped into the room. Most of this was in the upper part of the room; but even assuming that it was evenly distributed, we get the result that 5-12ths cubic foot of carburetted water gas in 3300 feet of air (or 1 part in about 8000) makes the air very disagreeable.

The poisonous action of illuminating gas depends almost entirely on the carbonic oxide which it contains. This unites with the hæmoglobin of the blood, and thus prevents the supply of oxygen to the various parts of the body. Investigations on the effects of carbonic oxide mixed with air have been very recently carried out by Dr. John Haldane, and the results published in the "Journal of Physiology" (Vol. XVIII., pp. 201, 430). The experiments were carried out first on mice, and then on the investigator himself. The results show—

> That any proportion of carbonic oxide in air below 0·02 per cent. (1 in 5000) is without any action; and a person can inhale such contaminated air for any length of time without hurt.
>
> That 0·045 to 0·05 per cent. (about 1 in 2000) begins to have an appreciable effect, but can be inhaled for four hours without very marked symptoms.
>
> That 0·21 per cent. (about 1 in 500) produces very marked symptoms. In the experiment, this mixture was inhaled for about 75 minutes, and the poisonous effects were strongly indicated.

We may, therefore, say that one part of carbonic oxide in 5000 of air is totally negligible; and that one part in 2000 just begins to be appreciable in its effects.

In the experiment tried at *B*, as the gas contained 32 per cent. of carbonic oxide, there was present in the air of the room only one part of carbonic oxide in about 25,000. The test was a severe one, on account of the exceptional height of the room in which it was made. If the gas had been thoroughly mixed, or if the room had been of average height, the time would almost certainly have come out much less than five minutes.

It follows from this that even pure carburetted water gas in the air of a room becomes very offensive from its smell long before it is dangerous as a poison; and the risk from its ordinary use may be practically neglected, as in the case of coal gas.

In the case of leakage into rooms where people are already asleep, or where people are unaccustomed to the use of gas for lighting purposes, the danger is certainly greater with carburetted water gas than with common coal gas, as the proportion of carbonic oxide is about three times as great. In the case of a mixture containing carburetted water gas and coal gas, in the proportion of one volume of the former to two of the latter, the percentage of carbonic oxide would be about 17 or 18, as compared with 10 to 11 in pure coal gas. Such cases of leakage are quite exceptional; and when they do occur, the amount of carbonic oxide in the air may become excessive, and the danger great, in a very short time, even in the case of common coal gas. So that the difference as between carburetted water gas and coal gas is small when compared with the total risk.

The increased amount of carbonic oxide is, therefore, no real objection to the introduction of carburetted water gas for illuminating purposes in place of coal gas.

With reference to the thermal value of carburetted water gas and coal gas, a good deal depends on the exact meaning to be put upon the expression "thermal value." The total amount of heat which it is possible to obtain from the combustion of a given quantity of gas, can be calculated when the exact composition of the gas is known. The

amount available under ordinary working conditions is different; and the two are not strictly proportional with different gases.

A rough indication of the heating effect can be formed from the proportion of oxygen (or of air) necessary for complete combustion of the gas. Experiments to determine this in the case of the two gases under consideration gave the following results:—

Edinburgh coal gas, 25-candle power . .	1 part required 6·4 of air.
B carburetted water gas, 21-candle power .	1 „ 5·9 „

For carburetted water gas of 25-candle power, otherwise similar to *B* gas, the proportion would be higher.

These numbers give us the ratio 9 : 10, which might be taken as roughly indicative of the relative heating powers of *B* gas and of Edinburgh gas.

As we do not know the exact composition of the heavy hydrocarbons (an investigation to get this would take a little time, and to get a proper basis for comparison which would be of much service, carburetted water gas of 25-candle power would also have to be examined), we can calculate the heating power from the heating powers and percentages of the various constituents only approximately. Assuming that the heavy hydrocarbons in *B* gas consisted of 10·5 of ethylene and 1·2 of benzene vapour, and that in Edinburgh gas they are one-sixth benzene vapour, one-third propylene, and one-half ethylene, the calculated relative heating powers are in the ratio 13 : 15; thus making the value for the *B* gas relatively lower than the above approximation. The composition of heavy hydrocarbons assumed here is, however, distinctly more favourable to the Edinburgh gas.

The Engineer of the *B* works stated that direct determinations had been made at their instigation, showing that their carburetted water gas came out about one-tenth lower than their coal gas. In actual use as a fuel carburetted water gas would show still better than in the above theoretical numbers; as, on combustion, it produces less water vapour than coal gas does. It may therefore be assumed that 25-candle power carburetted water gas of the *B* type would not be more than one-twentieth lower than the present Edinburgh gas as regards heating power; and a mixture in the proportion of 1 : 2 would differ in this respect very little from the present supply. Gas of the *A* type would be still lower than the *B* gas in heating power. It requires still less air for complete combustion. If the gas is intended only for illuminating purposes, this is a distinct advantage. It is apparent from the results stated in this report that the drawbacks generally urged against the use of carburetted water gas, are more imaginary than real.

On the other hand, there are distinct advantages. From a chemical point of view, the process of making illuminating gas from water gas and oil, is greatly superior to that of making it from coal. In the former case, great uniformity is possible, owing to the facility with which the operations can be controlled and adjusted. The process is also a very clean one, and free from many of the objectionable features of coal gas making.

It is claimed for carburetted water gas, that it is remarkably free from sulphur compounds. This we should expect, as practically all the sulphur compounds in the coke and oil must be converted into sulphuretted hydrogen, which is easily removable. (In the analyses of crude gas formerly given, the sulphuretted hydrogen is reckoned in with the carbonic anhydride, as it was not separately determined. The proportion present depends entirely on the amount of sulphur contained in the coke and oil employed.)

Should a water-gas plant be installed, a few experiments with simultaneous chemical examination would soon show the conditions necessary to give the most suitable product. Care should, of course, be taken that the plant allows of suitable control, by means of chemical examination from time to time.

I cannot conclude this report without acknowledging the very valuable assistance I have received in preparing it from Dr. Hugh Marshall. He visited and examined the works at *A* and *B*. He made a number of analyses on the spot, and also brought to Edinburgh specimens of the gas. At each place he received every attention and assistance from the engineers and other officials in charge of the works. Dr. Marshall's lucid description of what he had observed made it a comparatively easy matter to draw up the report.

University of Edinburgh, February, 1896. (Signed) ALEX. CRUM BROWN.

The following report by Mr. James Stenhouse, F.C.S., the Chemist attached to the Edinburgh Gas-Works, was also submitted:—

To ROBERT MITCHELL, Esq., Engineer and Manager.

Sir,—Acting on your instructions, I proceeded to *A* on Wednesday, the 12th inst., for the purpose of making a complete analysis of the carburetted water gas, as manufactured there. I was afforded every facility for carrying out the operations, by the Engineer and Manager, who was most courteous and obliging, and placed his laboratory at my disposal.

I consider it essential to direct your attention to the fact that the samples were taken from the main conveying the gas, as produced, from the generating house to the relief gasholder, on which pipe the exhauster was working, withdrawing the gas from the holder, and sending it through the purifiers and station meter. The composition of the gas in this pipe is, consequently, continually varying. This fact was not ascertained until two analyses had been made (Nos. 1 and 2), and accounts for the variations in the amounts of the ingredients, which should have agreed had the carburetted water gas been of constant composition. I append the results of my analyses, along with the illuminating power of the gas, as determined immediately before the samples were taken. The readings of the photometer varied considerably, which is in accordance with the statement made above as to the composition of the gas.

In order to obtain concordant results, a sample of gas sufficient for two tests was taken; and the results are given below (Nos. 3 and 4). I may add that the gas had a very decided and objectionable odour, resembling, in my opinion, the smell of ordinary coal gas.

	Sample No. 1. Per Ct.		Sample No. 2. Per Ct.
Sulphuretted hydrogen (H_2S)	0·0	..	0·0
Carbonic acid (CO_2)	0·1	..	0·4
Hydrocarbon vapours (C_6H_6)	0·9	..	1·2
Heavy hydrocarbons (C_2H_4)	12·4	..	8·6
Oxygen (O)	0·0	..	0·0
Carbonic oxide (CO)	30·4	..	31·7
Marsh gas (CH_4)	35·5	..	19·5
Hydrogen (H)	10·6	..	38·6
Nitrogen (N)	10·1	..	0·0
	100·0	..	100·0

Illuminating power of carburetted water gas at 10.5 a.m., 23·2 candles.

Sample No. 1 was taken at 10.30 a.m., and No. 2 at 10.50 a.m., on Feb. 13, 1896. The following samples were taken simultaneously, so as to compare results at 1.5 p.m., Feb. 14, 1896.

	Sample No. 3. Per Ct.		Sample No. 4. Per Ct.
Sulphuretted hydrogen (H_2S)	0·0	..	0·0
Carbonic acid (CO_2)	0·0	..	0·0
Hydrocarbon vapours (C_6H_6)	1·5	..	0·9
Heavy hydrocarbons (C_2H_4)	7·6	..	7·8
Oxygen (O)	0·4	..	0·0
Carbonic oxide (CO)	30·0	..	30·7
Marsh gas (CH_4)	29·3	..	32·8
Hydrogen (H)	19·9	..	18·0
Nitrogen (N)	11·3	..	9·8
	100·0	..	100·0

Illuminating power of gas determined at 12.50 p.m., 20·22 candles.

The Engineer and Manager requested me, if possible, to determine the percentage of carbonic oxide (CO), in the mixed coal and carburetted water gases, as supplied to the town for consumption. This I accomplished, and subjoin the figures, from which you will note that the mixture contains 20 per cent. of CO. The illuminating power of this gas would be about 20 candles.

ESTIMATION of CARBONIC OXIDE in a Mixture of Coal and Carburetted Water Gases (in Proportion of 2 : 1) as supplied to Consumers at "A."

		Per Cent.
	Carbonic acid (CO_2)	4·4
	Hydrocarbon vapours (C_6H_6) / Heavy hydrocarbons (C_2H_4)	8·7
	Oxygen (O)	0·0
	Carbonic oxide (CO)	20·3
Residual gas undetermined	Marsh gas (CH_4) / Hydrogen (H) / Nitrogen (N)	66·6
		100·0

ANALYSES of COAL GAS as Manufactured at the New Street Gas-Works.

[The samples were taken simultaneously at 8.30 a.m., Feb. 10, 1896, from outlet of station meter.]

	1st Analysis. Per Ct.		2nd Analysis. Per Ct.
Sulphuretted hydrogen	0·0	..	0·0
Carbonic acid	0·0	..	0·6
Hydrocarbon vapours	1·2	..	1·2
Heavy hydrocarbons	7·2	..	7·6
Oxygen	0·2	..	0·2
Carbonic oxide	9·6	..	9·8
Marsh Gas	38·4	..	38·4
Hydrogen	43·3	..	42·2
Nitrogen	0·1	..	0·0
	100·0	..	100·0

Illuminating power of gas determined at 8.30 a.m., 25·49 candles.

(Signed) JAMES STENHOUSE, F.C.S., Chemist.

Edinburgh, Feb. 18, 1896.

The Works Committee reported that they had considered the above reports, and they recommended that they should be authorized to introduce into the Edinburgh works the plant estimated for by Messrs. Humphreys and Glasgow. They also reported that the Economic Gas Apparatus Construction Company, Limited, had withdrawn their offer.

Bailie KINLOCH ANDERSON moved the adoption of the recommendation of the Committee. The Works Committee had been giving very serious and anxious consideration for a very long time to the method of making carburetted water gas. There was, in January last, a recommendation that the estimate for plant by Messrs. Humphreys and Glasgow should be accepted; but the Committee asked for a re-committal on the subject, as there was a feeling that the public possibly wanted a little reassurance—considering the remarks they heard, inside the Commission and outside—respecting the danger that might be associated with the distribution of this particular gas. It was recommitted, therefore, to consult Professor Crum Brown—the highest authority they could command, as a chemist, and to ask his views on the subject. The questions put before him were as to the safety of the use of the gas in their households, and as to its heating power. They had his report in their hands. Now it was not the proposal of the Commissioners to use carburetted water gas as an unmixed gas; but to use one part of carburetted water gas with two of coal gas. The report dealt with the proportions of the different gases, and brought out what they knew when they started this inquiry—that there was a greater proportion of carbonic oxide in it. When they had the assurance of an expert, such as Professor Crum Brown was, he (the speaker) thought they might, with all safety, that day determine to go forward and adopt that which had given the Committee so much consideration, and, he might say, so much anxiety. They were anxious that the public should be reassured—they felt assured themselves—else they would not have gone into the inquiry. He thought the fee which they had paid had been very well spent, as it had brought forward an admirable report, and one which was very gratifying to those who were identified with the scheme. He did not know that it was necessary to quote other authorities in the matter; but he would just like them to listen, for a moment, to Professor R. Ogden, of New

York, who stated that water gas was superior to all other gases, as it did not contain impurities found in gas manufactured from bituminous coal. Dr. Edward Frankland, too, of the Royal College of Chemistry, alluding to a report made by Professor H. Morton, in the "American Gaslight Journal," said he had no hesitation in asserting that water gas might be used with safety, both in public and private houses, and that he would be delighted to substitute this powerful illuminating agent for the gas with which his house in London was supplied, although it was used in all the bedrooms. He moved that they accept Messrs. Humphreys and Glasgow's tender.

Mr. Councillor HUNTER seconded the motion.

Bailie KINLOCH ANDERSON: This is always subject to our coming to an agreement.

The LORD PROVOST hoped that the members would take full notice of what had been said, and also of the report itself. It was of great public interest.

The recommendation of the Committee was adopted unanimously.

THE WATER-GAS PLANT FOR BIRMINGHAM.

The announcement made in the "JOURNAL" a few weeks ago that the Birmingham Corporation had entrusted to the Economical Gas Apparatus Construction Company, Limited, the largest order ever given at one time to any company in England for carburetted water-gas plant, induced the "Birmingham Post" to make some further inquiries into "what may be regarded as the most important development that has taken place in the Gas Department during the twenty years it has been under municipal control." The result was that our contemporary last week published an article dealing generally with the manufacture of water gas, and particularly with the plant which is about to be laid down. It is (as readers are aware) to be of the "Lowe" type, embodying the improvements of Messrs. Merrifield, Westcott, and Pearson. There is to be an installation both at the Windsor Street and the Saltley works. In each case, there are to be two complete sets of generating and carburetting apparatus, with ample condensing, washing, and scrubbing power; also "blowers," exhausters, engines and pumps, oil-heaters, &c.; each item being in duplicate, and each equal to the working of both sets of generators. At both works, the capacity of the plant is to be about 2 million cubic feet of gas per day; making four millions in all, or about one-sixth of the present production per diem. It is, however, in contemplation to add to the water-gas plant if satisfactory, and as the demand continues to grow, until it is equal to one-third of the make. The capital outlay upon the two installations, including buildings and oil-tanks, now ordered, will be about £60,000, as compared with at least £130,000 which would be required upon the most economical lines for coal-gas plant of corresponding capacity. The construction of the new works will be commenced forthwith; and it is expected that they will be completed by the end of September.

THE CHESTERFIELD GAS AND WATER WORKS ARBITRATION.

The Umpire's Award.

A Special Meeting of the Chesterfield Gas and Water Board was held on Thursday last, for the purpose of receiving the award of the Umpire (Sir George B. Bruce) in the recent arbitration between the Chesterfield Gas and Water Board and the Gas and Water Company. On the seal being broken, the particulars of the award were found to be as follows:—

For the gas undertaking	£106,500
For the water undertaking	125,336
	£231,836
Mortgage debt to be taken over	13,500
Total	£245,336

The Company's claim was £205,000 for the water undertaking, and £221,418 for the gas undertaking—a total of £426,418. The Gas and Water Board had offered £211,500 and mortgages—a total of £225,000. The Board have to pay the arbitration fees (£805); and their own costs and the taxed costs of the Company.

THE SETTLEMENT OF THE CHELTENHAM GAS QUESTION.

As mentioned in last week's issue, the Cheltenham Corporation and the Gas Company have come to an agreement upon the points of difference between them in connection with the Bill of the latter body. A report on the subject was submitted by the Lighting Committee at a special meeting of the Town Council yesterday week; and it stated the terms of settlement as follows: "(1) The share capital of £100,000 to be reduced to £80,000, and the loan capital to be one-fourth of this amount. (2) A testing-place to be provided in the town by the Company within 200 yards radius of the present Municipal Offices in the High Street. The illuminating power to be 15 candles on an average of three tests taken consecutively in one day within the parliamentary hours of testing, such testing-place to be under the entire control of the Company, with free access for the Gas Examiner to it within the parliamentary hours of testing according to the General Act. (3) The maximum sulphur compounds in 100 cubic feet of gas to be 25 grains. (4) The auction clauses to apply to mortgages and borrowed capital authorized by the Bill. In all other respects, the Bill to stand as now presented and signed by the Chairman of the Lighting Committee and the Directors. The petition to be withdrawn on the foregoing clauses being settled and signed by and between the respective Parliamentary Agents, and an undertaking given by the Company's Agents to insert the clauses as so settled in the Bill; and, upon the said clauses being so inserted, no other petition to be lodged in either House of Parliament or further opposition offered by the Town Council against the Bill." The adoption of the report was moved by Alderman Norman, who said he thought that, under the circumstances, the Committee had, by this friendly settlement, obtained as much as they would have done by an expensive fight in the Parliamentary Committee-rooms; and therefore the Corporation and the town were to be congratulated. In this connection, he ought to say that the Committee appreciated the personal courtesy with which they were received by the Directors of the Company; and the anxiety that was shown by the Directors, equally with the members of the Lighting Committee, to arrive at some satisfactory solution. The points on which advantage had been gained were three or four in number. First, there was the concession of a central testing-station, which, he believed, would be equal to an additional candle in the illuminating power, seeing that the Company would have to send gas from the works at so much above the minimum of 15 candles as to ensure the observance of the minimum in the centre of the town. Further, there was the reduction in capital, and what was perhaps more important, they had the requirement that the auction clauses should apply to the loan capital in the same way as to the share capital. Mr. Davis seconded the motion, in supporting which Mr. Lenthall said he did not think the action taken by the Corporation had been in vain, whatever exultation there might be on the part of some people at the non-approval by the ratepayers of the Bill for the purchase of the gas-works. The report was adopted.

SUGGESTED AMENDMENT OF THE METROPOLIS LOCAL MANAGEMENT ACTS.

Gas-Works Effluents in Public Sewers—Burst Water-Pipes.

A paper bearing the above title was read at a meeting of the Metropolitan Branch of the Association of Municipal and County Engineers on the 21st ult., by Mr. J. Patten Barber, M.Inst.C.E., the Surveyor to the Islington Vestry. Discussion on the paper was opened, and adjourned till the 11th inst. One of the subjects brought forward by Mr. Barber was the ventilation of sewers; and Mr. W. N. Blair, the Surveyor to the St. Pancras Vestry, expressed his agreement with the author on this point. He emphasized his remarks by referring to what had happened in the St. Pancras district. He said the County Council's sewer received the contents of the local sewers; and into one of them, a very short distance from the main sewer, the effluent from a gas-works was discharged. This effluent was at times very strongly impregnated with ammoniacal liquor and sulphur compounds, which gave off most offensive smells all along the line of the Council's sewer. Complaints were made by the public to the Vestry; and, on an examination being made, and it being found that the smells came from the Council's sewers, the attention of the Council was called to the matter. They referred it back, on the ground that the effluent was first discharged into one of the Vestry's sewers. They had to recognize that this was correct. But when they attempted to deal with the Gas Company, who were the offenders, they found themselves in a difficulty. Until the Act of 1894, there was no power authorizing a local authority to take proceedings against any person discharging offensive matters into sewers. In that Act a clause was inserted giving the Council power to prevent the discharge of offensive effluent, not only into their own sewers, but into local sewers discharging into them. The Act did not authorize the local authority to take proceedings; and in the case in question, they were unable to do so, and the Council declined. Therefore, except by calling the attention of the Gas Company to the offence, they were unable to do anything in the matter. Of course, the offence was reduced in degree after the complaint; but they were not able to take any effective steps to prevent what was a nuisance. There was also an important matter in connection with the roads to which he wished to call attention. They had in St. Pancras been landed in a very remarkable position. Some three years ago, during the night, a portion of Euston Road, between St. Pancras and King's Cross, was observed by a watchman to be rising. Eventually there was a terrific crack, almost like an explosion; and then the whole place was deluged by water. The Water Company's officers shut off the water; and although no injury was done to neighbouring property, considerable damage was caused to the roadway. It proved to be due to the fracture of a branch pipe from the Company's main supplying the Great Northern Railway. It was such a connection as the Company were not authorized to make; and the Railway Company had no statutory right to require them to put down such a pipe. It was laid by agreement more than twenty years ago; and it was supposed to have been done by the Water Company at the expense of the Railway Company. The Water Company repaired the pipe, and asked the Vestry's officers to restore the roadway, which was undermined for a considerable distance—the concrete in many places lying hollow. Eventually they reached the limits of the damage, and made the repairs, which amounted to £300; the Water Company's liability being only £12. In due time they charged the account to the Company, who returned it, and asked them to send it to the Railway Company. They, however, returned it, and said they were advised they had no liability. The Vestry then consulted their Solicitors, and Counsel's opinion was taken; and he advised they would not recover from the one or the other. The result was that they fell between two stools, and had to repair the road at their own cost. A similar case had occurred in the St. Olave's district; and the decision was that the Vestry could not recover the cost (see *ante*, p. 283). He thought such a thing should be provided for. After a prolonged discussion, a Committee of London Surveyors was appointed to consider and suggest amendments to the Metropolis Local Management Acts. The Committee's report will be submitted to the Vestries and District Boards in London, with the view to secure united action to obtain legislation to amend and consolidate the existing law.

LEEDS CORPORATION GAS SUPPLY.

Wages and Hours of Labour at the Works—Adoption of Retort-House Machinery.

At the Meeting of the Leeds City Council on Monday last week, the members had under consideration first the recommendations of the Gas Committee as to the demands of the men for certain alterations in their rates of pay and hours of labour, and later on a resolution relative to the acceptance of tenders for retort-house machinery for the New Wortley works.

The recommendations referring to the demands of the men were: "(1) That no change be made in the wages or hours of labour of the stokers, firemen, or coal wheelers; (2) that purifiers be put on the eight-hour day, with no advance of wages; (3) that no change be made in the wages or hours of labour of the yardmen; (4) that the cinder-throwers be placed on the eight-hour day, with no advance of wages; (5) that the enginemen be placed on the eight-hour day, with no advance of wages; that the employment of boilermen be discontinued, and that the present boilermen be employed as enginemen, or in some other suitable capacity; and (6) that the enginemen be paid for Sunday work at the present rate of wages."

Mr. LOWDEN, the Chairman of the Committee, moved the adoption of the foregoing. In doing so, he said that to grant in full the men's demands would result in an additional expenditure by the Committee of something like £9850 a year. In the first instance, the Committee declined to make any concessions whatever to the men. Afterwards there was a conference between the representatives of the men and a section of the Committee, the outcome of which was that they decided to grant some slight alterations in the working hours in certain departments. At the conference, he believed he was right in saying the men were convinced that they had been in error in some of the statements upon which they had based their application. The first reason which the men advanced for the action they had taken was that the work they had to perform had increased. Mr. Paylor, who was their chief spokesman, made a comparison between the work they had to do at the present time and that which was expected of them prior to the settlement of the gas strike in 1890. Bearing in mind the very changed conditions since then, it was somewhat misleading to make such a comparison. Prior to 1890, the stokers had to do the whole of the firing themselves. The men asserted that previous to 1888, they had only to carbonize 47½ cwt. of coal. As a matter of fact, before the settlement of the strike, no less than 52 cwt. were carbonized per man; and in 1888, the amount was not less than 51½ cwt. Mr. Paylor had endeavoured to make out that the men were now carbonizing 12 cwt. more per shift per man than prior to 1890. In 1894 the average was 55¼ cwt.; and in 1895 it was just short of 56½ cwt. So that the difference was not 12½ cwt., as Mr. Paylor had asserted, but about 4½ cwt. True, at the present time the Committee were having 60 cwt. carbonized per man, in accordance with the agreement of 1890, or 8 cwt. more than in 1890. Mr. Paylor advanced the strange contention that, if men were now bound to carbonize 60 cwt., they were entitled to more wages than they were receiving, because of the actual increase in their work, due entirely to the laxity of previous Committees. In other words, they desired an increase of wages for merely doing their duty. A second point advanced by the gas workers had reference to the quality of the coal. They said that the coal they had now to deal with gave them more work to produce satisfactory results. If there was one thing the Committee had full knowledge of, it was the quality of their coal. Their coals were regularly analyzed, and not more than 2 per cent. of it could be considered as "bad." In regard to Sunday labour, he hardly understood the position the men took up on this matter. Their wages, it was said, had decreased, because there was much less Sunday labour than there used to be. He (Mr. Lowden) had rather looked upon Sunday work as an extra. He should like to know if the men were seriously applying for a resumption of Sunday labour. He had been informed by Mr. Henry that one of the greatest grievances the men complained of at the time of the strike in 1890 was the question of Sunday labour. The men then urged that they wished to participate in all those means for recreation which were enjoyed by the majority of men in other walks of life. At any rate, whether this was so or not, the Committee had ever since acted under the impression that the men regarded Sunday labour as a grievance. Indeed, the Council would be astonished to hear what expense the Committee had gone to in order, as much as possible, to avoid Sunday labour. To quote Mr. Henry again, no less a sum than £50,000 had been spent at the Meadow Lane works alone for the purpose of supplying gas storage so as to minimize Sunday labour. The Committee contemplated an extension of their works at Meadow Lane, at a cost of something like £40,000. This would give them an addition to their present output of gas of something like one-sixth; but if the men now employed would work on Sunday, there was obviously no necessity for this great outlay. For the purpose of keeping the fires going on Sunday, yardmen were engaged; and one of the grievances of a section of the gas workers was that the Committee employed these men. He would commend this to the careful attention of the yardmen. The firemen got 5s. a day and 7s. 6d. on Sunday. The yardmen were paid 4s. a day of nine hours; and it was a nice addition to their income (and the labour was of a nature anyone could undertake) to be allowed to fire on Sunday. Yet the firemen made a grievance of this, and wished to prevent the yardmen from eking out their wages by Sunday labour. Then as to the coal-wheelers. Their complaint was that they had bogies to push about in addition to sweeping the rails on which the bogies ran. They had not advanced the other side of the question. In the contract of 1890, it was agreed that "each coal-wheeler shall be paid 4s. per shift, shall wheel 12 tons of coal per shift, quench the coke, and throw some on a heap." They had not now to quench the coke, and throw it on a heap. The Committee had declined to recommend that the wages of the stokers, the firemen, and the coal-wheelers should be advanced, believing that the rate of remuneration now paid to them would compare favourably with that paid in other branches of labour in the kingdom, and with the wages paid for the same class of labour in other parts of the country. The purifiers had not asked for an increase of wages, but for a reduction of hours. Knowing the disagreeable nature of their work, the Committee had agreed to recommend that their hours should be reduced to eight. It was proposed that cinder-throwers should have their hours reduced from twelve to eight; but with respect to the ordinary yardmen, who worked nine hours a day, they did not advise any concession. Enginemen, it was determined, should have their hours reduced from twelve to eight. They would be required, however, in addition to their ordinary work, to attend to the boilers. The present boilermen, if capable, could be turned into enginemen, and worked on the extra shift to be created. The men urged as another reason for putting forward their demands, that the gas-works were making more than a reasonable amount of profit. What were the facts? So far from making a reasonable profit, there had been a loss on the gas-works during the last ten years of £2651 14s. 9d. True, there was a large surplus last year; but it had resulted from a special effort that was made to wipe out a deficit. The surplus undoubtedly was the result of reducing the illuminating power of the gas, and of putting up the price 2d. per 1000 cubic feet. He did not, however, wish it to be assumed for a moment that he admitted the right of gas workers to have any share whatever in the profits as gas workers. They were entitled to no greater share than other members of the community. The works belonged to the Corporation; and if there was a loss, the gas consumers had it to pay. Only last year, the gas consumers had £24,000 to pay—the expense of the coal strike. If there was any profit, it belonged to the community; and, as members of the community, the gas workers would share in it. If they were paid fair wages—wages that would compare favourably with the remuneration paid for other branches of labour, and with the wages paid for the same class of work in other towns—it was all they could expect. The Committee were hoping to make large profits during the present year, and had definite objects in view as regarded their disposal. They were going to create a reserve fund, to enable them to avoid fluctuations in future in the price of gas, and to provide a working capital to reduce their enormous overdraft at the bank. After this, any profits there were would be for the benefit of the community at large. The Committee wished the Council to share responsibility with them in this matter. If they decided to make further concessions, the Gas Committee would acquiesce. If they decided to reduced the recommendations, the Committee would regret it; if they accepted the Committee's recommendations in full, all they asked of the Council was that they would give them their support, and enable them to acquit themselves with credit to the Corporation.

Mr. BATLEY proposed, as an amendment, that the recommendations of the Committee be adopted, except that referring to yardmen, and that these men have their hours reduced to eight per day.

Mr. CONNELLAN did not see why the Council should be severe with the men simply for trying to get the best conditions they could for themselves. The fact that the Committee had made certain concessions proved that the men had some ground for complaint. The cinder-throwers, for example were working twelve hours a day for 21s. a week. He was glad to see the Committee had thought it advisable to recommend a considerable concession in their case. As to Sunday labour, he did not think the men really wanted any regular system of Sunday labour; but they desired some small concession in the shape of extra pay for Sunday work.

Alderman WALKER said the position of a member of the Gas Committee had not been an enviable one. They had to superintend a plant which cost about a million and a quarter sterling; the annual turnover was something like £350,000; and they had an average of about 1000 men to look after. He supported the contention of the Committee that the men were fairly remunerated.

Mr. HENRY denied that the men were much harder worked now than before the strike. Prior to 1889, at the Meadow Lane works, there were simply stokers and coalmen; and these worked in shifts of twelve hours. It then took 188 men to look after the works; and the cost was £44 6s. 8d. a day. After the strike was settled, it took 268 men; and the daily cost was £63 19s. 8d.—a difference of £19 13s. He trusted that on the present occasion the Committee would feel they had the Council at their back, and sincerely hoped the affair would not turn out the fiasco it did on the last occasion. He did not anticipate there would be a strike; for he believed the men felt that reasonable justice had been done to them. The Corporation gained knowledge by experience; and their misfortunes in 1890, they now realized, were largely due to not taking the public into their confidence. If necessary, he hoped they would not hesitate at any reasonable expenditure in order to let the public know the facts. If they did so, he was sure the Committee would come out of the crisis with great credit to themselves and to the Corporation.

Mr. AMBLER failed to see anything that had taken place since 1890 to warrant the men in making an application for increased pay. If the labourers in the yards were canvassed, 90 per cent. of them, he undertook to say, would express satisfaction with their present conditions.

Alderman HEPWORTH supported the amendment. Eight hours a day, he thought, was quite long enough for any man to work.

Mr. LAYCOCK hoped Mr. Lowden would consent to make an additional concession on behalf of the yardmen.

Alderman BAKER thought that, with a little contrivance and slight inconvenience, the yardmen could have their hours reduced to eight.

Mr. LOWDEN pointed out that the yardmen were only employed during the day; and any reduction in their hours would interfere with the convenient working of the stations.

The amendment was lost; only five voting for it. A second amendment for the firemen to receive time-and-a-half pay for Sunday work, met the same fate; and the recommendations of the Committee were eventually adopted unanimously.

Mr. LOWDEN then proposed—"That the Council approve the acceptance by the Gas Committee of tenders for fitting retort-houses at New Wortley works with stoking machinery as follows, subject to such modifications or reductions as the Gas Committee may approve, viz., West's Gas Improvement Company, Limited, for No. 3 retort-house, at a sum not exceeding £5692; Sir William Arrol and Company, for No. 4 retort-house, at a sum not exceeding £4950. And that the sum of £2000 be granted to the Committee for works connected therewith."

The resolution was at once adopted.

LEICESTER CORPORATION GAS, ELECTRICITY, AND WATER SUPPLIES.

The Half-Yearly Accounts.

At a Special Meeting of the Leicester Town Council last Wednesday, the accounts of the gas, electricity, and water undertakings for the half year ending Dec. 31 last were presented.

The Gas and Electric Lighting Committee reported that from the accounts of the gas undertaking, it appeared that the net profit, after paying interest on the capital, was £14,838. Out of this sum had been paid £3154—the half year's proportion of the sinking fund; leaving a balance of £11,684, which, added to the net profit (£9584) for the half year ended June 30, 1895, made a total of £21,268, to be applied to the district fund at the close of the current financial year (the 31st inst.). The Committee recommended that the sum be so applied.

Alderman LENNARD, the Chairman of the Committee, in moving the adoption of the report, said the chief feature was that the net profit for the half year was £11,684. This, he regretted to say, was a decrease of £1164 compared with the corresponding period of 1894. For the whole year the net profit was £21,268.

Mr. BILLINGS seconded the motion.

The MAYOR inquired if any steps had been taken by the Gas Committee to consider the desirability of manufacturing water gas.

Alderman LENNARD said the matter had been under the consideration of the Committee for some years; and the question of adopting the system would be again discussed when the time came for increasing the manufacturing plant. Replying to a question as to the purchase of meters from consumers owning them, he said the amount of compensation so far paid was between £300 and £400.

The motion was adopted.

The accounts of the electric lighting undertaking, for the half year ended Dec. 31, showed that the result of the working, after paying interest on capital and £580 on account of sinking fund, was a deficiency of £195. This sum, together with £1142 loss to June 30 last, made a total loss in connection with the department of £1337. The amount which had been paid on account of sinking fund was £1298.

Alderman LENNARD, in moving the adoption of the report, said that, considering this was only the second half year of the department, the fact that the net loss was only £195 was exceedingly satisfactory, and more than justified the statement he made some three years ago, when he was considered by many members as being rather too sanguine.

Mr. BILLINGS seconded the motion, which was carried.

The Water Committee reported that the net profit, after paying interest on the capital of the undertaking, was £6243. Out of this had been paid the sum of £2467, the half-year's amount of the sinking fund; leaving a balance of £3776, which, added to the net profit (£2479) for the half year ended June 30, 1895, made a total of £6255. The Committee recommended that £1255 be paid to the reserve fund, and that the balance of £5000 be transferred to the district fund at the close of the current financial year. The quantity of water delivered during 1895 within the limits of supply had been 1,296,388,619 gallons; and the average consumption of water per day per head of the population supplied had been 16·83 gallons—including the quantity supplied for trade purposes. The number of houses on the books at the end of December was 42,642; giving an estimated population of 213,210, which was an increase at the rate of 1·73 per cent. per annum. The Committee also reported that they had arranged with Messrs. Hunter, Fraser, and Goodman, for the supply, delivery, and fixing of six sets of their patent sand-washers in the filter-beds at Swithland reservoir, at the price of £1492 10s.

The MAYOR, in moving the adoption of the report, said the department had made during the year a little over £6000; and they asked the Council to allow £1255 to be put to the reserve fund. It was gratifying that they had such a sum in hand when they considered the vast sums they had spent in the year. They had expended £71,000 on the Swithland works, and other sums which were entirely unproductive. Proceeding to refer to the state of the water supply, the Mayor said that the mains from Thornton to Leicester were small; and they could only carry 1½ million gallons of water per day. It would not do to depend upon Thornton, as they were consuming between 3 and 4 million gallons of water per day. They were not in the position they would like to be. They had had this year about 3 inches of rainfall; but it had been intermittent, and had not benefited the brooks. They had four months' stock of water. They were not free from anxiety, because the demand was increasing so largely. At the present time they were supplying 111 million gallons per month; and the demand was increasing. They had been reluctant as a Committee to restrict the service of water; but he thought it wise not to allow the public to live in a Fool's Paradise, but to ask them to be as careful as possible with the supply. It would be a very serious thing for Leicester unless they had some rain shortly, because they would have no water available from Swithland until the end of the year or the beginning of next. If they could get over the coming six or eight months, they were absolutely safe for some years. But if the population went on increasing at its present rate—it was now 213,000—the water supply would only last a few years; and the Council would have to look out for further sources of supply.

Mr. COLEMAN seconded the motion, which was adopted.

The Gas Committee have decided to reduce the charges to consumers by penny-in-the-slot meters by 15 per cent., which will make the price nearly the same as for ordinary consumption—viz., 2s. 4d. per 1000 cubic feet.

Cost of Opposing the Chesterfield Gas and Water Bill.—The Taxing Master of the House of Commons has certified that the cost of the opposition to the Chesterfield Gas and Water Bill last year amounts to £1766; and the Local Government Board have allocated the proportions to be paid by the various Local Authorities who took part in the opposition as follows: Chesterfield, £1203; Newbold, £284; Whittington, £279.

OPPOSITION TO GAS AND WATER BILLS.

Last Tuesday, at a meeting of the Surrey County Council, the Parliamentary Committee reported with respect to the Aldershot Gas and Water Bill, under which the promoters seek to extend their limits to the parishes of Farnham, Seale, and Wanborough, but with the reservation that the obligation to serve the extended area shall be limited to the distribution of such surplus water as may remain after supplying the existing district in Hampshire. It appeared to the Committee inequitable that Surrey parishes should not have, as regarded the use of water found in Surrey, a preferential (or at least an equal) claim to parishes in another county. Moreover, the question whether any water procured within the county should be diverted to another, without the consent of the authorities, was a very important question. The Committee recommended that steps should be taken to oppose the Bill; and this was agreed to.

A poll of the owners and ratepayers of Bexhill was taken on Monday last week with regard to the resolution of the District Council to oppose the Bill of the Bexhill Gas and Water Company now in Parliament. The main grounds of the opposition are associated with the refusal of the promoters to insert clauses under which the Council may compulsorily acquire the undertaking by purchase at any time. The result of the poll was declared on Wednesday. About 1350 voting-papers were distributed; and the total poll enumerated 1067 votes. Of these, 601 were for, and 466 against opposition, or a majority of 135 in favour of the proposal of the Council. We learn from a local correspondent that there is a strong feeling in the neighbourhood that the Bill would not have been opposed at all but for the fact that it contains a clause whereby the Company seek power to obtain a Provisional Order in connection with electric lighting, which is regarded as an opposing scheme to the one being promoted by Lord De la Warr (the Chairman of the Council) and another gentleman.

THE MATLOCK BATH GAS COMPANY'S PROVISIONAL ORDER.

Last Tuesday, Lieut.-Colonel ADDISON held an inquiry at Matlock Bath relative to an application by the local Gas Company to the Board of Trade for statutory powers. At the onset Mr. Hextall, for the applicants, explained that the Company had been in existence since 1852, when it was formed with a capital of £2000, to supply the district with gas. Since that date, the capital had been increased to £4500; and last year, on the valuation of Mr. J. Ferguson Bell, the Engineer of the Stafford Gas-Works, it was increased to £10,000 by a distribution of a bonus of £5 per share to the shareholders, with the option of taking with the money new stock then issued. With only a few exceptions, stock was taken in lieu of the cheques. Evidence was given by Mr. A. Clark, the Secretary of the Company, Mr. J. Reeds, the Chairman, Mr. T. Newbigging, the Engineer, and Mr. Derbyshire, the Auditor, in support of the Company's case. These witnesses were cross-examined at length by Mr. Ram (on behalf of the District Council) who endeavoured to adduce reasons why no bonus should have been issued. There was opposition from a number of ratepayers from Bonsall, headed by Mr. James Wright, the late Chairman of the District Council; and Mr. Brooks handed in evidence in opposition to the steps taken by the Council to support the Company's application. He said a meeting of the ratepayers had been held when there was a strong feeling against the proposal. It was stated by a Mr. Donegani that, at the meeting referred to, there was an amendment carried in favour of abandoning the proposal for gas lighting, and to go in for electricity. A deputation from Cromford said they had not been considered by the Company; and they were opposed to the application, unless a proviso were inserted giving them permission, should they erect works, to take from the Company the Cromford district. After consideration, the suggestion of the Cromford Parish Council was accepted by the Company; and their opposition was withdrawn. In summing up for the Matlock Bath District Council, Mr. Ram said he should not call any evidence; but he held that the case for the Company was a bad one on the face of it. He reserved his defence because the whole matter would, he said, be gone into by a Committee of the House of Commons. The inquiry then closed.

THE DRIFFIELD GAS-WORKS PURCHASE QUESTION.

Local Government Board Inquiry.

An inquiry has been held at Driffield, by Mr. G. W. WILLCOCKS, into the matter of the application by the Driffield District Council for a Provisional Order to empower them to purchase the local gas-works.

Mr. STEPHENSON represented the District Council; Mr. MANISTY, the Gas Company.

Mr. STEPHENSON, in opening his case, stated that the Company promoted a Bill in Parliament in 1894, which the then Local Board intended to oppose. Certain persons mediated between the authority and the Company; and an agreement for purchase was come to on March 10, 1894. A second agreement, containing clauses such as were necessary to give effect to the first or provisional agreement, was dated Nov. 11, 1895. The resolution of the District Council to carry out the latter agreement by applying for a Provisional Order was passed by five votes to four; one member remaining neutral, and one (who was a shareholder in the Company) being absent.

Mr. *G. B. Tonge* supplied some particulars as to the history of the Company. He said it was formed by deed of settlement, dated Sept. 7, 1835, under the name of the Driffield Gaslight Company. On Jan. 16, 1845, the Company was registered pursuant to the Joint-Stock Companies Act. On November 10, 1862, it was registered under the Companies Act, 1862, as an unlimited Company; and the affairs were now regulated by the deed of settlement as from time to time altered and amended by resolution. Originally the capital was £1800 in £10 shares, which had since been increased to £12,000; and there was no money

borrowed on mortgage or debenture. The price of gas at present was 2s. 11d. per 1000 cubic feet, subject to a small discount to users of gas-engines, which was a lower price than the average charged by District Councils supplying gas in Yorkshire.

Mr. *White*, who opposed the application on behalf of himself and other ratepayers, said he was in favour of the Council purchasing the gas-works under the provisional agreement entered into on March 10, 1894, which was executed at a time when the Company were promoting a Bill in Parliament to obtain statutory powers, and thus create for themselves in Driffield a monopoly in the manufacture of gas. The chief opposition to the Bill, however, was with regard to the site of the works. The Company also sought to obtain power to manufacture and store gas not only on the then and now existing site, but to do so on other real estate adjoining, on both sides of the beck—thus considerably extending the area of the works, and increasing the liability of the beck to contamination by the bye-products. The District Council had never up to the present time had expert evidence to show whether the gas-works were in such a state as would permit of their being carried on on the present site. He thought, if the Council took over the works, they should be removed to another site, either by the side of the railway or the banks of the canal, and not be left in the centre of the town. He thought that a clause might be inserted in the Provisional Order that the works should only be carried on temporarily, and not permanently, on the existing site. As to the valuation, it was greatly in the interests of the town that it should, as suggested by the Local Government Board, be made before the Order was granted.

Mr. *M. Samuelson*, the Consulting Engineer to the Council, then handed to the Inspector a written report on the condition of the works, which it was decided, seeing that an arbitration must follow should not be read.

Mr. *G. H. Potts*, as the owner of adjacent property, objected to the site. His property, he said, was now empty; and people who had looked over it had objected to the smell from the gas-works.

The Inspector subsequently visited the works, accompanied by a representative of each side.

THE TIVERTON CORPORATION AND THE GAS-WORKS.

Local Government Board Inquiry.

An inquiry was held at Tiverton last Wednesday, by Major-General Phipps Carey, R.E., into an application by the Corporation for a Provisional Order for the purchase of the gas-works.

The Town Clerk (Mr. C. M. Hole) stated that the Corporation entered into an agreement on March 13, 1895, for the purchase of the undertaking, which was the property of Messrs. Heathcoat and Co.; and during the past year they had carried on the works by arrangement with the vendors. It was proposed to give £20,000 for the works. They were valued by Mr. Eaves, a gas engineer, who put the worth of the undertaking at £16,300 and the stock at £727—making a total of £17,027; while Messrs. Oxborough, accountants, certified that the average gross profits of the past three years, after allowing depreciation, were £1373 per annum.

Mr. Loosemore, a ratepayer, who said he represented a considerable body of opinion adverse to the Council's procedure, protested against the Corporation giving £20,000 for works which had been valued at £17,000. Mr. Heathcoat purchased the works more than fifty years ago for about £5000 from a Company which had been unsuccessful. No doubt the works were much improved; but he thought some of the mains were very old and defective.

The Surveyor (Mr. J. Siddalls) said that the oldest main was laid in 1860, and he believed they were all sound.

Mr. Loosemore also pointed that five years ago the Corporation spent £500 in obtaining an Electric Light Provisional Order; and he suggested that Messrs. Heathcoat were anxious to sell in view of future developments.

It was explained that the Corporation had not decided to go in for the electric light, but the Board of Trade had granted an extension of time under the Order until the purchase of the gas-works was completed. The Corporation own land adjacent to the gas-works suitable for an electric light station.

The Surveyor remarked that gas-engines could be used to work the dynamos if the electric light were adopted. Explaining why the Corporation had decided to give £20,000 for works valued at £17,000, the Surveyor said they thought it an exceedingly good business, and that it was desirable for the ratepayers to possess it. The profits had been more during the past twelve months than in any one of the three years included in the valuation.

The Inspector said the object did not appear to be to supply the district with gas so much as to do away with competition.

The Surveyor said the profits of the past year were between £1800 and £1900. In similar places, where transfers of gas undertakings had taken place, the valuation was not less than twenty years' purchase.

The Inspector remarked that this was largely based on the state of the works.

The Surveyor replied that there was no prospect of a large outlay except on renewals; and for this they made provision by asking for a loan of £22,000, which gave a margin of £2000 over the purchase-money.

Mr. Loosemore contended that this was a purely commercial speculation on the part of the Corporation—depending entirely on the state of the plant, and on what had to be laid out, on the future consumption of gas, and how far gas would be superseded by any other system of lighting. It also depended to some extent upon a clause in the agreement by which the vendors reserved to themselves the right to have gas supplied to their lace factory at a cheaper rate than any other consumers. At the present time, Messrs. Heathcoat were having the electric light installed at the factory; and this would considerably reduce the receipts at the gas-works.

Mr. J. Thorne, a member of the Town Council, said that, when the valuation of the gas-works was made, it was publicly known that the electric light was to be introduced at the factory. There had been no petition to the Council against the purchase, no public meeting in opposition to it; and though two municipal elections had been held, none of the candidates had referred to, or was questioned upon, the purchase.

The Surveyor said the factory was now charged at the rate of 3s. 7d. per 1000 cubic feet, and other consumers at 3s. 11d. The latter had been the price for the last eight years, previous to which it was 4s. 5d. Messrs. Heathcoat paid £500 a year for gas; but if they ceased to be consumers, the loss to the Corporation would be only £70—the profit upon this sale. The Corporation paid for public lighting about 10 per cent. less than ordinary consumers. If the loan were granted for forty years, the charge for principal and interest would be about £880 per annum. The make of gas in 1884 was 21,780,000 cubic feet; in 1893, 28,802,000 cubic feet; and in 1895, approximately 30,000,000 cubic feet.

Mr. *W. Littlewood*, the Gas Manager, was called, and said he had known gas-mains last fifty years; and he asked the Inspector, in fixing the maximum price, to take into consideration the fact that Tiverton was an inland place, and that the cost of the carriage of coal was very high indeed.

The Surveyor remarked that if gas were sold at 4s. per 1000 cubic feet, and there was a surplus, the price would be reduced.

The inquiry then closed.

THE SANDWICH CORPORATION AND THE GAS-WORKS.

Local Government Board Inquiry.

On Thursday, the 12th inst., Colonel J. O. Hasted, R.E., held an inquiry at Sandwich, on behalf of the Local Government Board, in regard to an application made by the Sandwich Corporation for a Provisional Order authorizing them to acquire by agreement the Sandwich Gas Company's undertaking.

The Town Clerk (Mr. D. Baker), in support of the application, said that on July 12, 1839, the Corporation granted a lease of the land on which the works now stood, for a term of 75 years; and later leases had been executed for the land on which the gasholder had been erected. But all were so arranged as to fall in at the same time. There were the usual repairing covenants in the leases, under which the Gas Company were bound to erect and maintain proper buildings in good order, and "hand them over in thorough sound and proper condition" at the termination of their tenancy. The present scheme arose in this way: The Gas Company in 1894 gave notice to determine their contract with the Corporation for the public lighting, with a view of increasing the charges; but the proposal was thought by the Corporation to be hardly justified by the circumstances. As a result, negotiations ensued for the purchase of the gas-works by the Corporation; and Mr. E. H. Stevenson was called in. He advised that the town could be best lighted with gas, and that this illuminant had certain advantages over electricity, since it could be used for cooking and heating besides lighting. The Company also engaged an expert—Mr. H. E. Jones; and he, considering the peculiar position of the Company and the circumstances of their tenancy, advised them to come to an agreement with the Corporation. The negotiations were proceeding favourably; but owing to the period of the year, the Corporation took, as was sometimes done in these cases, a double course, and issued a Parliamentary Notice for a Bill for compulsory purchase and also a notice for a Provisional Order. The shareholders of the Company had agreed to terms of purchase; but it was found necessary to proceed with the Order, as the Local Government Board declined to entertain any application for a loan unless the Corporation possessed the powers conferred by an Order.

The Inspector asked why the maximum price of gas was put so high as 5s. 6d.

The Town Clerk said the minimum was placed at 3s.; and the present price was 4s. 7d. Through the courtesy of the Company, he was able to state that the average cost of coal delivered during the last five years at the gas-works had been 18s. 4d. per ton. The coal was brought by sea, and up the River Stour; and though Sandwich was only a mile and a quarter from sea direct, the vessels had to be towed up the river some seven or eight miles. There were coal dues of 10d. per ton levied under a Local Act passed about the year 1757 to provide funds for paving the town. They did not, however, think they would get to the maximum price for gas, though in these days of strikes it was best to be on the safe side. The Company had to pay 20s. 6d. per ton in the year of the coal strike; and in 1893 only 16s. per ton delivered in the Stour.

Mr. *E. H. Stevenson*, M.Inst.C.E., said that if the Inspector would turn to clause 28 he would see that the Corporation could take no profit from the revenue until the price was down to 3s. This was one of the smallest concerns to be found in the Parliamentary Returns as to gas undertakings—making less than 6 million cubic feet of gas per annum; but when they had new and improved works, they hoped to sell much more.

The Inspector said sixty years had been applied for as the term for the repayment of the loan; but Parliament would not grant it for more than forty years now. As a matter of fact, the Local Government Board in this case would not sanction more than thirty years.

Mr. *Stevenson* said the present works had been in existence about thirty-five years; and they were not at all in good condition—the plant being inadequate, and inefficient for present-day requirements. The gasholder, for instance, was about 25 years old, and had only just half the proper capacity for the maximum quantity of gas produced. Its working capacity was 18,000 cubic feet; and the maximum make in January, 1895, was 36,500 cubic feet. He had no doubt whatever that if the holder capacity had been about 40,000 cubic feet, the output would have been considerably more; but it was impossible to properly serve a district unless they had a day's supply in the holders. New works would be necessary, on a different site altogether.

Some further evidence as to details having been given, the inquiry closed.

FATAL EXPLOSION AT THE CHELTENHAM GAS-WORKS.

The Cheltenham Gas-Works were the scene of an explosion early last Thursday morning, which resulted in the death of one man and injury to two others. It appears to have been due to an escape of gas into a boiler, and to its ignition by a workman. The boiler was one of a pair previously used to generate steam for the engines which worked the coal-crushing machinery, but which, consequent on recent alterations at the works, have now been placed in the coal and coke stores near the retort-house. Before putting them to the new use intended for them, it was found necessary to clean them; and this work was entrusted to John Bird, Edwin Robins, and Harry Derrett. On one of the boilers, the men were engaged all day on Wednesday. For lighting the interior of the boiler while the men were at work, they were provided with a gas-burner attached to a flexible tube. Apparently, no flaw was discovered in the tube on Wednesday; and whether there was one in it at all, will never be known for certain. The unfortunate fact to be noted is that the piping was not removed from the boiler when the men ceased working on Wednesday night, and that, either from leakage or from accidental re-turning on of the tap after the light had been extinguished, sufficient gas escaped to practically fill the boiler. The existence of the manhole would probably have prevented an accumulation of any considerable quantity of gas had not the workmen carefully covered it. The men prepared to resume their work early on Thursday morning; and it was then that the explosion occurred which cost one of them his life. Bird ascended the masonry and removed the covering from the manhole, made no remark to his companions as to a smell of gas, but at once proceeded to descend into the boiler. He was followed on to the masonry by Robins and Derrett, who, however, made no attempt to go further until Bird should have lit up their place of work. Standing at the mouth of the manhole, Derrett became aware of the presence of gas in the boiler; and he called to his mate in the boiler. But no reply came; and almost immediately afterwards the explosion occurred. At the time of striking the light, Bird must have been immediately under the manhole, for the force of the explosion lifted his body through it to the roof of the building—a height of about 10 feet. The explosion threw the other men down in opposite directions; and in each instance, the face and upper part of the body—particularly so as regards Robins—was burnt. The noise of the explosion brought help from all parts of the works; and Mr. J. A. Coombes, the Assistant-Manager, and Mr. Cardew, surgeon, also quickly arrived on the scene. Nothing could, of course, be done for Bird. It was seen that Robins was suffering considerably from his injuries; and he was sent to the Hospital without delay. Derrett, not being so badly injured, was taken to his home. The deceased man was fifty years of age; and he had been in the service of the Gas Company for twenty years.

THE ACCIDENT AT THE FORFAR GAS-WORKS.

Mr. Vernon Harcourt's Report.

To the Assistant-Secretary, Board of Trade.

Sir,—Referring to your minutes of Dec. 31, 1895, directing that a formal investigation of an accident which occurred at the gas-works belonging to the Forfar Corporation should be held, and appointing me to hold such an investigation, I beg leave to report as follows:—

Having obtained from Mr. William Gordon, Solicitor to the Forfar Gas Corporation, an account of the circumstances of the accident, and a plan of the part of the retort-house in which it occurred, and having arranged with him as to the production of witnesses and the time and place of the investigation, I went to Forfar, arriving about 6 a.m. on the 22nd ult. Accompanied by Mr. Gordon and Mr. Forbes Waddell, the Manager of the gas-works, and by Mr. Smith, the Manager of the Aberdeen Gas-Works, who had been asked, at my request, to attend and give evidence, I visited the scene of the accident, and went round the works. At 11 a.m., I opened the investigation in the Council Hall, and examined as witnesses the Manager of the works, eight of the men employed on the works, and Mr. Smith, of Aberdeen.*

The circumstances of the accident were briefly as follows: At about 9 a.m. on Monday, Nov. 11, 1895, the making of gas was stopped in order to make some new connections; and it was resumed at about 7 p.m. Two sets of retorts were then charged, connecting with two separate hydraulic mains; one being a setting of six retorts, and the other of eight. Adjoining the setting of eight was a setting of four retorts which had not been used. The mouthpieces of these retorts were connected with four out of eight dip-pipes, which entered the same hydraulic main as those of the setting of eight. This main was provided with two overflows—one from the bottom for tar, and another, along the foul main at the end of the hydraulic main, for liquor. Between 7 and 8 p.m. all the retorts were charged, and three of the setting of eight, in which light charges had been placed, were re-charged between 9 and 10 p.m. At about 10 o'clock a fourth retort was re-charged. At about 9.20 p.m., the feed-pipe of the boiler being out of order, the exhauster had been stopped, and the gas led through a bye-pass to the purifiers.

When two retorts in the setting of six had been re-charged, at about 10.10 p.m., and another retort in the setting of eight was being drawn, a loud bubbling was heard, and a large volume of gas took fire at the mouth of the ascension-pipe. To stop this escape of gas, the stoker was ordered by the Manager to close the lid. The Manager and stoker then set to work to open wide the lids of the four adjoining retorts which were not in use. The lids had been left partly open; and the Manager saw gas coming out. When three lids had been opened, and the stoker was opening the fourth, which was nearest to the live retorts, the gas ignited, and some of the brickwork of the furnace and two of the ascension-pipes were blown out by an explosion. The Manager and the stoker, who were immediately in front, were both of them knocked down and injured. They had, I am glad to say, completely recovered by the time of my visit.

Before the retorts were charged at 7 p.m., one of the stokers put about four pailfuls of water into the hydraulic main, and observed subsequently, after gas making had commenced, that liquor was running from the overflow into the well. After the explosion, the same stoker again mounted on to the top of the bench of retorts, and poured some pailfuls of water into the main through one of the dip-pipes. Gas was still burning at the mouth of the broken pipes; but when the second pailful was poured in, the flame gradually sank down and went out. The seal then adjusted itself, and gas making continued without further interruption, though the exhauster could not be set to work till some time afterwards.

Several witnesses stated that the breaking of the seal and the return of gas through the ascension-pipes had happened on previous occasions; and one witness, who had been dismissed from the post of foreman about three months previously, stated that he had seen gas coming back into one or other of the pipes two or three times in a week.

As to the immediate cause of the accident there is no doubt. The pressure of gas in the hydraulic main drove liquor and tar up into the dip-pipes which were not connected with charged retorts, till gas could make its way past the bottom of the dip-pipes up through the column of liquid, and out into the air through the open lids. When the lid of the empty retort, which was nearest to, and only a few feet distant from, the retorts in action, was thrown open, the mixed gas and air took fire and exploded, not only within the retorts but in the flues around, into which gas from these retorts had penetrated. I incline to think that it was an error of judgment on the part of the Manager to open these lids. If water had been poured as quickly as possible into the hydraulic main, the seal would have been restored, and the ignition of the gas in the unused setting might probably have been avoided. On the other hand, it was possible that there might be such an opening in the wall which divided the two settings (produced by unequal expansion) that the explosive mixture, having only a small vent at the mouth of the retort, might have passed through and been inflamed.

The cause of the difficulty in which the Manager found himself, and ultimately of the explosion, was that the quantity of liquid about the mouths of the unused dip-pipes was not sufficient to provide as high a column of liquid within the pipe as was needed to withstand the pressure of the gas in the hydraulic main.

The Manager, who seemed to be an energetic and capable man, was of opinion that some obstruction had been caused for a short time and then removed, as might be done by the closing and opening of a valve. My attention was called, when I went round the works, to a chain and padlock which had been placed since the explosion to prevent tampering with the valves at the inlet of the purifiers; and in the plan sent me an opening is shown at this point in the enclosure of the works which is marked "Open access." Gas-works ought to be properly fenced in; so that no mischievous person could enter unseen and turn a valve. It seems to me, however, extremely improbable that the accident was due to such a cause. One of the stokers, who poured water into the hydraulic main after the explosion, stated: "I put in two pailfuls at the bridge-pipes. The flames were coming out; and when I put in the water, the flame went away. It went gradually down with the second pailful I put in." On the theory that someone was tampering with the valves, it would be necessary to suppose that at the same moment at which the second pailful was being poured in, the valve was being re-opened. The same witness added subsequently that he heard a slight bubbling after the second pailful, and so put in two pailfuls more.

The Manager pointed out that as the area of the hydraulic main is sixteen times as great as that of the dip-pipes, in which water must have mounted when the exhauster ceased running, a seal of 1 inch should have sufficed even against a back-pressure of nearly 16 inches. He believes also that the actual seal was 2 inches, and the pressure only 5½ inches. If this were so, and if the space around the ends of the dip-pipes were free from solid or semi-solid matter, and if the hydraulic main were level, the breaking of the seal could not have happened except by some sudden, exceptional pressure. It is, however, in evidence that on former occasions gas had come down the ascension-pipes; and the Manager had spoken severely to his men on the subject.

I think it probable that several causes contributed to the return of gas which produced the explosion. The double arrangement for the overflow of tar and liquor makes the actual level of liquid in the hydraulic main less certain. The connection of one hydraulic main 23 feet in length with two sets of retorts, one in action and the other cold, is likely to cause some disturbance of level. The pressure required to send the gas through the condensers, scrubbers, and purifiers into the holder would vary from time to time with the position of the holder and the make of gas; and in the actual condition of the charges might well be at a maximum at the time of the accident. But the principal cause is, I think, to be found in the effect upon the liquid at the bottom of the hydraulic main of ten hours' rest and cooling. The tar would become pasty, and might also be thickened by the ammonia salts which are sublimed into the main and crystallize out from the liquor. As a consequence of this, the effective area of the liquid in the hydraulic main which was available for rising in the unused dip-pipes when the exhauster stopped, may have been very largely reduced, so that a pressure of 6 inches, or perhaps more, lowered it to near the bottom of the dip-pipes. A dip which would be sufficient if the liquid were at rest, becomes insufficient in consequence of the agitation produced by the bubbling through of the gas.

The first breaking of the seal happened, as was likely, when one of the setting of retorts in operation was open. Here the agitation would be much greater than in the other half of the hydraulic main. As soon as the gas began to blow through the column of 6 inches or more of liquor in the 7-inch dip-pipe, a violent bubbling would be heard, due to the length of the column, the size of the pipe, the high pressure of the gas, and the reverberation of the ascension-pipe—reinforced perhaps by the open mouthpiece and retort. Some liquor and tar would be splashed up and blown away through the bridge-pipe and down the ascension-pipe—further reducing the seal, and causing such waves in the liquor as to allow gas to reach also the bottom of

* Mr. Harcourt enclosed with his report a transcript of the notes which were taken by a shorthand writer at his request. Our report of the inquiry will be found in the "JOURNAL" for Jan. 28 (*ante*, p. 181).

the dip-pipes in the idle half of the main. Here more liquor would be thrown out—accounting, I think, for the bespattering with tar of the Manager's coat, especially when the explosion had occurred and the gas was blowing out through the broken ends of the ascension-pipes, beneath which he was lying unconscious.

A piece of evidence already quoted—that the pouring in of a few pailfuls of water was sufficient to restore the seal—strongly supports the supposition that the available area of liquor in the hydraulic main had been very much reduced. Had the main been clear, a few pailfuls of water could hardly have made a sufficient difference in the level to restore the seal.

Although I am disinclined to attach any blame to the Manager, who had taken charge of the works comparatively recently, and who certainly acted with energy and to the best of his judgment and knowledge, and should think it unjust to order that the costs of the investigation should be paid by a man upon whom the explosion itself inflicted a more than sufficient penalty, I am of opinion that such an accident might be avoided by one or two simple precautions.

The main around the dip-pipes must be cleared out sufficiently often, and especially after the making of gas has been suspended. The syphon for drawing off tar from the bottom of the main should be carefully fixed, and some better means provided for knowing at what level the tar is flowing off. Some plan should also be adopted for quickly raising the level of the liquor in the hydraulic main. Perhaps the simplest might be to provide a water-pipe which would discharge into the main, with a tap accessible from the floor of the retort-house, and a sliding plate, which might form part of a hydraulic main valve, to vary the level of the overflow. I suggest that it would also be well to have two gauges, in some part of the retort-house, where they would be easily observed—one showing the pressure upon a retort in action, the other showing the pressure in the hydraulic main.

In gas-works on the scale of those at Forfar (where it may be too expensive to provide apparatus in duplicate, so as to be safe against a breakdown of the exhauster), the seal must be, or must be capable of being made, sufficiently deep for safety when the exhauster has to be stopped. Such a seal adds only another 2 inches or so to the 6 inches of pressure otherwise produced. On such occasions, a loss of gas is inevitable. But this may be of less moment than the cost of providing apparatus in duplicate; and it should certainly be preferred to the risk of an accident which might issue in loss of life.

Cowley Grange, Oxford,
Feb. 13, 1896. (Signed) A. VERNON HARCOURT.

Hollington Water Supply.—Colonel J. T. Marsh, R.E., held an inquiry last Wednesday week into an application to the Local Government Board by the Battle District Council for authority to borrow £1600 for new water-works. Evidence was given as to the inferior quality of the present water supply of Hollington, which is derived from shallow wells; but objection was raised to the proposed new source (a well 141 feet deep), on the ground that the water was so full of oxide of iron that it required filtering twice before it could be employed for drinking purposes, and so corrosive as to be unfit for use. The Inspector promised to bring before the Board the various points raised; and he took a sample of water for analysis.

The Price of Gas at Teignmouth.—The Teignmouth District Council continue to meet with difficulties in reference to the financial position of their gas undertaking. A special meeting was held last Wednesday, to consider a resolution of which Mr. Jarvis had given notice to increase the price of gas. Before the resolution was submitted, the opinion of the Clerk was invited as to the regularity of the proceeding, seeing that the notice did not cover the rescinding of a resolution of September, 1891, by which the price was fixed at 3s. 9d. per 1000 cubic feet. The Clerk held that the resolution ought to be rescinded before any other motion on the subject was considered. Mr. Jarvis endeavoured to elicit information as to the cost of manufacturing gas; but objection was then taken that, as the meeting was called to consider a resolution which was out of order, discussion upon it was irregular. It was, however, decided to issue warrants of distress for unpaid gas accounts; and with this the abortive proceedings came to an end.

The Arrol-Foulis Hydraulic Stoking Machinery.—Additional Arrol-Foulis hydraulic stoking machinery is about to be fitted up at the Vauxhall Station of the South Metropolitan Gas Company. The plant, which is to be ready for work by next winter, will include two charging and two drawing machines; the former being of novel construction. Instead of the usual method of raising the coal by large elevators, and afterwards depositing it in fixed hoppers, from which the supply for the chargers can be drawn, only small elevators will be used, and these will in this instance be attached to the chargers themselves, and will be capable of raising the coal, when the machine is in any position of its travel, from the floor of the house, and filling the small hopper attached to these chargers. As the elevators will lift direct from the skirt of coal, no manual labour will be required in connection with the operation. The Company have also ordered for their Rotherhithe station several of the Arrol-Foulis hydraulic machines, all of which are to be ready by next winter.

Sligo Gas Company.—At the recent annual meeting of this Company, the Directors reported a net profit of £736, out of which they proposed, after providing for interest on the 4½ per cent. preference shares, adding a further £100 to the reserve fund, to recommend a dividend at the rate of 6 per cent. per annum, free of income-tax. This would absorb £675. The price of gas had been reduced from the 1st of April last, from 5s. to 4s. 2d. for lighting, and from 3s. 4d. to 2s. 9d. for cooking and heating purposes; and the Directors reported that the public had taken advantage of this large reduction in price, and that the consumption had so increased that the profits remained about the same as before. The rise in the consumption had been caused chiefly by a large number of new consumers both for lighting, cooking, and heating purposes. During the year, 40 automatic prepayment meters, 63 ordinary meters, and 58 cooking-stoves had been fixed. The works and plant (under the supervision of Mr. C. B. Tully) had been maintained in a thoroughly efficient state. The report was adopted.

SALES OF GAS AND WATER SHARES.

In accordance with the notification lately made in our advertisement columns, Mr. Alfred Richards conducted an important sale of gas and water companies' stocks and shares at the Auction Mart, Tokenhouse Yard, last Wednesday. We alluded a fortnight ago to the keenness displayed to secure portions of similar stock offered for competition at a recent sale, as exemplified by the numerous gathering of capitalists who had assembled; and on the present occasion, the crowd was much larger. The auctioneer had a choice collection of stocks to put up; and some remarkable prices were realized. The first lot was a parcel of 6 per cent. preference "K" stock of The Gaslight and Coke Company, which was bought at the rate of £164 per £100; returning the investor £3 13s. 2d. per cent. Some "A" ordinary stock was sold at £301 per cent. Some 4½ per cent. perpetual debenture stock of the Commercial Gas Company was purchased at the rate of £147 per £100; returning the buyer £3 1s. 3d. per cent. Consolidated old stock of the same Company, carrying 13½ per cent. dividend, was knocked down at £336 10s. per cent.; bringing the purchaser 4 per cent. on his investment. A small quantity of the Company's new stock was sold at the rate of £258 per £100; returning £4 1s. 5d. per cent. Two £100 lots of the Hornsey Gas Company's 5 per cent. preference stock found a purchaser at £141 each; some "B" stock (7 per cent.) fetching from £182 to £184, and "C" stock £183, per £100. The West Ham Gas Company's 4 per cent. perpetual debenture stock was sold at £126 per cent.; some original fully-paid £5 shares, bearing 9½ per cent. dividend, realizing from £12 7s. 6d. to £12 15s. each. "A" stock of the Tottenham and Edmonton Gas Company, the last dividend paid on which was at the rate of 11½ per cent. per annum, was knocked down at £290 per cent.; some "B" stock (8½ per cent.) fetching at the rate of £212 10s. per £100—practically a 4 per cent. return over the whole. Original £10 shares in the Lea Bridge Gas Company, earning for several years 10 per cent. per annum, found purchasers at £30 each; original £5 shares in the Romford Gas Company, carrying the same dividend, were bought for £12 10s. each, while "B" shares in the same Company fetched £8 15s. apiece. Perpetual debenture stock (5 per cent.) of the Enfield Gas Company was sold at £151 10s. per £100; and some 6 per cent. preference stock at the rate of £157. The West Kent Gas Company's original £10 shares, the last dividend on which was at the rate of 8 per cent. per annum, were sold for £20 10s. each; and some new 7 per cent. shares (£4 paid), at £8 5s. each. Original 10 per cent. stock of the Worthing Gas Company was bought at the rate of £246 per £100; while some £10 shares (7 per cent.) fetched £16 10s. each. Some fully-paid £10 shares in the North Camp and Farnborough District Gas Company, Limited, which did not declare any dividend for the past year, were sold at a premium of 5s. each. A parcel of £320 of the Bournemouth Gas and Water Company's 4 per cent. mortgage debentures was sold for £326 10s.; some £10 "B" (7 per cent.) shares producing £19 apiece. "A" stock of the Barnet District Gas and Water Company, bearing 9 per cent. dividend, was sold at the rate of £230 per £100; while some "D" stock (water), on which £6 6s. per cent. per annum has been paid, fetched at the rate of £177 per £100. Perpetual debenture stock (4 per cent.) of the West Surrey Water Company was sold at the rate of £130 per £100; £10 preference shares (5 per cent.) found purchasers at £12 10s. each; and fully-paid shares of similar nominal value entitled to a maximum dividend of 7 per cent. were knocked down at £13 7s. 6d. and £13 10s. each.

Among recent sales, the following have to be recorded: At Guisborough, some shares in the Redcar, Coatham, Marske, and Saltburn Gas Company were sold for £19 and £19 15s. each.——A number of shares in the Bodmin Gas Company were sold by auction in that town last Tuesday. A parcel of 137 "A" shares, of £5 each (£4 12s. paid up), on which the dividends for the past ten years had averaged 9½ per cent., were sold in lots of five at from £8 14s. to £8 19s. per share. A similar number of "B" shares, £1 paid, on which the dividend for 1895 was 5 per cent., realized from £1 to £1 3s. each. Four fully-paid £10 shares in the Bodmin Water Company, bearing 2½ per cent. dividend, were sold at £6 11s. each.——At a local sale of shares last Wednesday, £20 original shares in the Windsor Royal Gas Company realized from £44 10s. to £45 10s. Some new shares (£20 paid) produced £32 5s. each; and £8 preference shares sold for £11 and £11 5s. apiece.

ELECTRIC LIGHTING NOTES.

Statistics as to the growth of the electric lighting business in Sheffield are supplied in the annual report of the local Electric Light and Power Company. The concern has now been in operation for three complete years; and in 1893, the gross revenue from the supply of current was £3555, in 1894 £4849, and in 1895 £6935. During the past year, £16,427 was expended on machinery, mains, and other apparatus; and the Directors are proposing to offer to the present shareholders 3375 additional shares at a premium of 10s. The balance brought from the last account was £532; and the net profit for the year, £3391. After paying the interest on the debentures, writing off a proportion (£200 of the formation expenses, transferring £750 to the depreciation fund, and paying a dividend of 5 per cent. per annum, there will be a balance of only £88 to carry to the accounts of the current year.

The Electric Lighting Committee have reported to the Wakefield City Council that they have obtained the provisional approval of the Board of Trade for the supply of electrical energy, subject to certain regulations, and that the Town Clerk has been directed to urge the Local Government Board to sanction the borrowing of the money required (£25,000) as soon as possible.

Having regard to the installation of the electric light in Chester, the Corporation have agreed that the present arrangement with the Gas Company for the lighting of the city shall continue for only six months, instead of twelve. With reference to the electrical scheme, the Mayor (Mr. B. C. Roberts) announced, at the last meeting of the

Council, that there was an increase in the estimate for machinery and plant for the station, which made the amount £15,600, as against £14,200. This advance was through the addition of arc lights for the streets; but the total expenditure would be within £22,000.

The Newmarket District Council, at their meeting on the 9th inst., decided, by a majority of two, to apply to the Board of Trade for a Provisional Order to sanction the carrying out of an electric lighting scheme. The Surveyor (Mr. J. W. Metcalf, Assoc.M.Inst.C.E.) had been instructed at the previous meeting to prepare a report on the subject; and this he submitted. In the course thereof, he said he had carefully considered the question of disposing of the house refuse by means of a destructor, and utilizing the steam generated for running the electrical machinery, thereby reducing the coal bill. He found, however, that the interest on the capital outlay, together with the cost of labour, would not warrant the Council in incurring the extra expenditure. He estimated that an installation capable of supplying 4000 8-candle lamps connected could be worked at £600 per annum, after paying interest on the capital and providing for the sinking fund. He did not think the installation would cost more than £10,000. The profit could be applied either in the reduction of the cost to the consumers, or placed to the credit of the rates. The cost of production might be taken as follows: Total works expenses, £1350; interest on £10,000 loan, at 3 per cent., and repayments to extinguish it in 30 years, £510; total £1860. Revenue, 72,000 units per annum, at 8d. per unit, £2400, besides meter-rents. By having their own electric lighting station, the Council could, he said, economize in capital, outlay, and maintenance expenses, and would be able to supply private consumers at a moderate rate. He suggested that the site for the works should be near the railway; or it might be at the sewage farm.

Seeing that several references have been made in these columns to the question of electric and incandescent gas lighting at Dover, the figures contained in the first annual report of the local Electric Lighting Company will be of interest. It is seen that the Company have secured private business to the amount of £525 12s. 3d., and public lighting to the extent of £478 17s. The year's working closed with a balance on the wrong side of £1711 (nearly £1000 loss on the working, and over £700 interest on loan).

For some time the leading tradesmen in Bolton have complained about the charges made by the Corporation for the electric light, and a deputation representing nine-tenths of the consumers recently waited upon the Gas and Electric Lighting Committee in regard to the matter. It was urged that the price now charged for the new illuminant was so much in advance of gas that many were compelled to go back to the old light, though they had spent large sums in fittings. One case was mentioned, and proof given, that the tradesman was paying three times as much for the lighting of his workrooms by electricity than was the case when he used gas to a very large extent. It was stated that, if the present prices were maintained, tradesmen would be compelled to return to the use of gas. They asked the Committee to adopt a sliding-scale, and abandon the present uniform price; and they submitted that the arrangement adopted at Brighton should be tried in Bolton. There the initial charge is 7d. per unit for an average of one hour per lamp per day; and beyond that average 3d. per unit, with a meter-rental charge of 2s. 6d. per quarter. The Committee intimated that the arguments adduced by the tradesmen would be considered; and the matter was eventually referred to a Sub-Committee for report.

Last Sunday week, a considerable portion of Kingston was in darkness, owing to some flaw in the main supplying the arc lamps in the High Street, the Market Place, and some of the other streets. Several public-spirited townsmen, however, came to the rescue, and lit up their outside lamps; the incandescent burners being supplied from a separate main. By this means nearly all the dangerous corners were lighted.

PETROLEUM LAMP ACCIDENTS.

A report by the chief officer of the Public Control Department of the London County Council as to the causes of petroleum lamp accidents, and as to the measures necessary for preventing them, has been issued. Statistics are given showing that the number of petroleum lamp accidents has increased from 19 in 1866, with no cases of death or injuries, to 473 in 1895, with 23 deaths (a number regarded as under-estimated) and 44 cases of injuries. The conclusions indicated in the report are summarized as follows: "(1) That the number of accidents arising from the burning of mineral oil in lamps has increased, and is still increasing, notwithstanding the voluntary efforts made for preventing them; and that effectual means of prevention can only be found in compulsory measures. (2) That raising the flash-point fixed by the Petroleum Acts would not alone be effectual in preventing lamp accidents, as this would not prevent the sale and use for illuminating purposes of oil below that flash-point. (3) That the prohibition of the retail sale and the prevention of the use for illuminating purposes of mineral oil below a flash-point sufficiently high to prevent all lamp accidents would be effectual, if it were practicable. (4) That the prohibition by statute of the sale of unsafe lamps would be another means of putting an end to lamp accidents, as both experience and experiment have proved that mineral oils such as are now in common use can be safely burnt in properly-constructed lamps. (5) That a practicable method of preventing the sale of unsafe lamps would be by a clause similar to that submitted to the Select Committee on Petroleum in 1894." The clause in question specified that the Secretary of State might from time to time by order make, and when made, rescind, and alter, specifications of lamps or other appliances intended to be used for burning mineral oil for the purposes of illumination, heating, cooking, or otherwise; and it was to be unlawful for any person, on and after a date to be named, to keep, expose, or offer for sale, or sell any such lamp or other appliance, unless constructed in accordance with one of such specifications. Any person keeping, exposing, or offering for sale, or selling any such lamp or other appliance not so constructed was to be liable, on conviction, to a penalty of not exceeding £5, and to the forfeiture of the lamp or other appliance.

THE LONDON COUNTY COUNCIL AND THE EAST LONDON WATER COMPANY.

At the Meeting of the London County Council last Tuesday, the Public Control and Water Committees jointly presented a report with regard to the course of events in connection with their proceedings against the East London Water Company for deficiency of supply. The report detailed the conclusions arrived at by Colonel Ducat and Dr. Barry, the Local Government Board Inspectors, after the inquiry held in October last, an abstract of which was given in the "JOURNAL" last week, and then continued: "We have received a report from the Engineer upon the Inspectors' conclusions, copies of which have been sent to the members of the Council. He is of opinion that the scarcity of water was principally due, not to failure of supply, but to leakages in the distributing-pipes—a contention which appears to be borne out by figures contained in the Water Examiner's last report, published since the Local Government Board inquiry. We have again taken Counsel's opinion, who advises that the report of the Local Government Board Inspectors would be a serious obstacle in the way of successful proceedings, and that it would therefore be wise to proceed no further. We therefore recommend that the proceedings commenced against the East London Water Company under section 16 of the Metropolis Water Act, 1871, be discontinued, and that the Solicitor be instructed accordingly." Sir J. Dimsdale moved, as an amendment, that the words "and apologies be sent to the Company" should be added to the recommendation. He said the money of the ratepayers had been spent in making unfounded attacks upon the London Water Companies; and the Council now found that this particular Company had carried out their duties and responsibilities with great ability under trying and difficult circumstances. The action of the Council in this matter had ended in a painful *fiasco*. Mr. Bicker-Caarten seconded the amendment. After some remarks, it was put and lost; and the recommendation was agreed to.

METROPOLIS WATER SUPPLY.

The Government Scheme for the Formation of a Water Board.

As recorded in our "Parliamentary Intelligence," the Government Bill for the better control and regulation of the water supply of the Metropolis and the surrounding districts was introduced in the House of Lords, on Monday last week, by Lord James of Hereford, and read the first time. Its title is the Metropolitan Counties Water Board Bill, and its provisions are as follows:—

I.—A Board shall be established for the purpose of dealing with the supply of water to so much of the counties and county boroughs of London, Middlesex, Essex, Hertford, Kent, Surrey, West Ham, and Croydon (in this Act referred to as the Metropolitan Counties) as is situate within the Metropolitan Water Area; and this Board shall be a body corporate by the name of the Metropolitan Counties Water Board, with power to acquire and hold land for the purposes of this Act without licence in mortmain, and is in this Act referred to as the Water Board.

II.—The members of the Water Board shall be appointed as follows: Sixteen by the London County Council; two by the Common Council of the City of London; two each by the Councils of Middlesex, Essex, and West Ham; one by the Council of each of the other Metropolitan Counties, one by the Conservators of the River Thames, and one by the Lea Conservancy Board.

III.—There shall be transferred to and vested in the Water Board, when established, all the powers of the Metropolitan Authority under the Metropolis Water Act, 1871 (34 and 35 Vict., cap. 113), and all other powers of the London County Council in relation to the Metropolitan Water Companies or the supply of water, except such of those powers as are vested in the London County Council as the authority for sewers, roads, or bridges, or in relation to the fire brigade, or to the reservoir in Finsbury Park; and the enactments, whether public general or local and personal, relating to the powers so transferred, shall be construed as if the Water Board were substituted for the Metropolitan Board of Works, the Metropolitan Authority, and the London County Council, as the case requires.

IV.—(1) The Water Board shall have power to inquire into and enter into negotiations and make and adopt provisional agreements respecting any matters relating to the water supply of the Metropolitan Water Area, and to take such steps for promoting or opposing any Bills in Parliament as may appear to the Board necessary or expedient in relation to the water supply to that area; and any such Bill may provide for altering the extent of the Metropolitan Water Area and for making any consequential alteration in the constitution of the Water Board.

(2) Any such Bill promoted by them may be introduced as a Private Bill; but if opposed, shall be referred to a Select Committee of which some members shall be nominated by the House in which the Bill is pending.

(3) The Water Board shall have the same power of making a complaint with respect to the quantity or quality of water as is given by section 9 of the Metropolis Water Act, 1852 (15 and 16 Vict., cap. 84), to the householders mentioned in that section; and the provisions of that Act shall apply accordingly.

(4) The Water Board may aid any inhabitant of the Metropolitan Water Area in obtaining the determination of any question which appears to the Board to be of general interest to consumers of water, or to any class of such consumers, with respect to the rights and liabilities of any of the Metropolitan Water Companies, or otherwise with respect to the supply of water given, and the charges made, by those Companies, and may take such legal proceedings as may appear to the Board necessary or expedient for the protection of the interests of consumers of water in respect of the matters aforesaid.

(5) Any person authorized by the Water Board in that behalf may enter and inspect any premises within the Metropolitan Water Area

for the purpose of ascertaining whether there has been any violation of the enactments with respect to the supply of water within that area.

V.—(1) The expenses of and incidental to the exercise by the Water Board of their powers and duties under this Act shall be defrayed by the Councils of the Metropolitan Counties in proportion to the total annual value of the parishes in each county situate within the Metropolitan Water Area, and supplied wholly or partly with water by any of the Metropolitan Water Companies; but any parish which is not so situate or so supplied shall be exempt from contribution towards those expenses.

(2) For the purposes of this section, "annual value" shall mean the value as determined for the purpose of the county rate; or in the case of a county borough, for the purposes of the borough rate.

VI.—The Metropolitan Water Act, 1852 (15 and 16 Vict., cap. 84), except section 3 thereof, and the whole of the Metropolis Water Act, 1871 (34 and 35 Vict., cap. 113), shall extend to the whole of the Metropolitan Water Area, and shall have effect as if the expression "Metropolitan Water Area" were substituted therein for the expressions "Metropolis," and "limits of this Act" respectively.

VII.—(1) The members of the Water Board shall be appointed at such times and in such manner, and shall hold office for such time, as may be fixed by the Council or other authority appointing them: Providing that—(*a*) One-third, as nearly as may be, of the members appointed by the London County Council shall retire in every year; (*b*) the members appointed by any other Council shall not continue in office for more than three months after the next triennial election of councillors of that Council, or in the case of a county borough or of the City of London, or of any other authority, for more than three years; (*c*) a retiring member may be re-appointed; (*d*) the county councillors elected for the City of London shall not vote in the appointment of members by the London County Council.

(2) A member of the Water Board need not be a member of the Council or other authority by whom he is appointed.

(3) A person interested otherwise than as ratepayer or consumer of water in any Metropolitan Water Company shall not be qualified to be a member of the Water Board.

(4) The Water Board shall, with respect to their proceedings and quorum, the appointment and powers of a chairman, the appointment, powers, and proceedings of committees, the provision of an office, and the appointment of officers for the execution of the duties of the Board, be in the same position as if they were a County Council.

(5) The accounts of the Water Board and their officers shall, for the purpose of the enactments relating to the audit of accounts of County Councils, be deemed to be accounts of a County Council and their officers.

VIII.—(1) The first appointments of members of the Water Board shall be made before the expiration of *one month* after the passing of this Act.

(2) The first meeting of the Water Board shall be convened as soon as practicable by the Local Government Board. The clerks of the several Councils and authorities appointing members of the Board shall send to the Local Government Board written notice of the names and addresses of the persons elected to represent those Councils and authorities respectively. The Board shall be deemed duly convened if notice is sent to the persons of whose names the Local Government Board has so received notice at the address specified in the notice; and the Board shall be deemed duly constituted notwithstanding any vacancy in their body or the entire non-representation of any Council or authority.

IX.—In this Act, unless the context otherwise requires, the expression "Metropolitan Water Area" means the County of London and every parish outside that county to the whole or any part of which any Metropolitan Water Company is for the time being authorized to supply water; and the expression "Metropolitan Water Company" means any of the Companies specified in the schedule to this Act.

X.—This Act may be cited as the Metropolitan Counties Water Act, 1896.

The following is the schedule above referred to: The Governor and Company of the New River brought from Chadwell and Amwell to London, commonly called the New River Company; the East London Water-Works Company; the Southwark and Vauxhall Water Company; the Company of Proprietors of the West Middlesex Water-Works; the Company of Proprietors of the Lambeth Water-Works; the Governor and Company of the Chelsea Water-Works; the Grand Junction Water-Works Company; the Company of Proprietors of the Kent Water-Works.

Press Opinions on the Government Scheme.

"The Times" does not say that "the plan contemplated in Lord James's Bill is the best conceivable; but it is a practicable scheme, and whatever friction it may involve is probably much less than would be produced by the concession of absolute power to the London County Council."

The "Standard" says: "The Government Bill dealing with the water supply of the Metropolis and the surrounding districts is not an elaborate measure; but it has evidently been prepared with great care and discrimination. It provides the requisite machinery for the purchase of the undertakings of the Water Companies, but prudently avoids any attempt to settle the terms and conditions of purchase—this being left to the future judgment of Parliament. The Bill clearly brings us within measurable distance of a transfer of the water supply of London and its suburbs from the Companies to a public body. The Government are avowedly open to any suggestions calculated to improve their measure; and although it may be said that the Bill simply creates a new authority, to which the main task will have to be confided, this appears to be the only way in which a long-contested subject can be brought to a successful conclusion."

The "Morning Post" considers that "the proposals of the Government cannot be regarded as a settlement of this complex and important question. It is right to add that no such claim was put forward on behalf of the measure by its sponsor. Her Majesty's Government, he explained, have framed their Bill upon the assumption that there exists a great and growing opinion that the time has come when the management of the water supply of the Metropolis and the surrounding districts should be vested in the hands of a responsible and public representative body. . . . Ministers have determined, and in our judgment rightly determined, that the new municipal body shall not be the London County Council."

The "Daily Telegraph" thinks it will be "good news to Londoners that a serious attempt has at length been made to grapple with the question of the Metropolitan Water Supply." The Londoner, it is said, "does not much care whether his water in the future is to be obtained from the Thames or the chalk, from suburban reservoirs or Welsh mountains. But he does demand that there shall not be a niggardly, grudging way of doling out the fluid; and that whether he wants it for drinking or for ablutions, or for any other purpose, he shall have enough of it and to spare. He wants it good, plentiful, and cheap. If the measure foreshadowed by Lord James will secure this result for him, he will welcome it with grateful satisfaction."

The "Daily News" says: "If there ought to be such a thing as a London County Council at all, there is nothing more strictly within the sphere of its influence than London water. . . . Lord Tweedmouth took the sound view when he urged that the proper Water Trust would be a Statutory Committee of the Council. The Trust to be created by Lord James's Bill has every vice. It is miscellaneous, irresponsible, clumsy, incongruous, and weak. Unless the ratepayers of London bestir themselves, and put pressure upon their representatives in the House of Commons, they will have to pay smartly and long for Tory prejudice against the Council and all its works."

The "Morning Advertiser" does not see any grave objection to the constitution of one authority for the whole water area of London, assuming the necessity for such body to exist. But that necessity, our contemporary thinks, Lord James did not make clear. "He said he recognized the necessity for making the control of the London Water Supply a municipal matter; but for our own part we fail to find any mark of municipality in his Water Trust. It is certainly a matter on which the London County Council is entitled to be heard. If it shall find in the Water Trust any satisfaction of its municipal aspirations in this direction, we shall certainly be much surprised. Lord Tweedmouth described the Bill as one for excluding the London County Council from the management of its own water supply. The description does not seem altogether unjust. It may be that the London County Council would not make the best conceivable Water Authority for London. But it is difficult to discern the grounds upon which the Water Trust can base any better claim to the confidence of Londoners."

The "Daily Chronicle" asks: "What is the Trust to do when it is constituted, if, indeed, it ever comes to the birth?" The writer goes on to say: "Lord James tells us that the Water Companies are to be acquired some day; but the Trust is not to have any particular powers given to it until it makes known its wishes. . . . In other words, the position of the Trust will be that it will have to take Private Bills to Parliament just as the County Council does at present. But the promoter of these Bills, instead of representing a homogeneous body, will be members of a compulsory and artificial partnership, with little in common, and destitute of the direct mandate which alone can enforce the surrender on fair terms of great and greatly abused monopolies to the community. We agree with Lord Tweedmouth that this is a move to exclude the London County Council from an effective voice in the London Water Question. Such a measure would never have been offered to other cities that have come to Parliament for powers of purchase. And, in spite of the rebuffs to municipal progress in the capital, we venture to doubt whether this sham Trust will be accepted by the people of London."

The "St. James's Gazette" says: "The Government's Water Bill is, on the whole, likely to be satisfactory. The constitution of the new Water Board is fair, and representative of the whole great area of Water London, which is even larger than Greater London. The vexation displayed by Lord Tweedmouth, after Lord James of Hereford had explained the Bill, was a little overdone. The London County Council has worked hard, we admit, to get the control into their own hands, and spent a good deal of time and money on preliminary inquiries and negotiations. But they had been warned all along that they would not be given power over the water supply to an area far greater than, if not so populous as, the County of London. But they are to have a clear majority of representatives on the new Trust; and, if they urge their views reasonably, they should obtain a still greater preponderance. If the Progressives are wise, they will make the best of an inevitable arrangement—one which commends itself to that body of average sensible opinion which cares very little about municipal politics."

The "Globe" says: "The Government Water Bill proposes to create a new London. We have already Corporate London, Metropolitan London, Postal London, and Police London. Lord James's measure will give us what its author calls a Water London. The general scope and main provisions of the Bill will commend themselves to the approval of Londoners in general, both within and without the municipal limits. There may be room for improvement in details. But the scheme as a whole is well considered; and it is only to be hoped that time may be found to carry it through both Houses this year."

The "Westminster Gazette" characterizes the Government measure as a "wizen, attenuated, rickety little creature in the guise of a London Water Bill;" and it says that, whether it is passed or not, it is not likely to solve the London water problem.

The "Pall Mall Gazette" considers that the way was paved for the proposed Trust by the Committee which sat last year, under Lord Rathmore (then the Right Hon. D. Plunket). "The composition of the Trust," says our contemporary, "is fair to all parties, and even generous to the London County Council. Lord Tweedmouth's contention that the London County Council area, with four-fifths of the population of the present area of supply, is only to appoint a bare majority of the Board, is disingenuous. The minority is not distributed among the authorities of the other fifth of the population, but is largely absorbed by the exceptional interests of the City and the Conservancy Boards. Moreover, the predominance of the London County Council—now an important factor—will become proportionately less as the extra-suburban populations increase; and it is no answer to

this to say that the County Council will, some time or other, extend its area, as the outer communities may object to be absorbed, and may prefer to retain their separate areas and local government."

The "Evening News" says that to "Lord James of Hereford are due the thanks of London for having devised a municipal and representative body which will include all the interests concerned; giving due prominence to the County Council, while protecting the suburban bodies which are outside its sphere of control—a body which is judiciously safeguarded from the unbusinesslike turmoil of politics, and which retains a fully representative quality without imposing on London the fatigue of yet another municipal election."

The "Star," on the other hand, is of opinion that the Government Bill can have no other result than to entangle and delay the solution of the Metropolitan Water Question.

The "Manchester Guardian" thinks what it characterizes as the "fantastic" London Water Supply Bill "shows the length to which London Toryism will go for fear and dislike of the London County Council." The writer says the Government propose to upset everything by creating a new Water Authority on which the London County Council would have a bare majority of representatives. The creation of such a body is absolutely without precedent, and would add a new element to the existing confusion of local government.

The "Engineer" says: "The Government have acted with diplomatic skill. Undertaking to deal with the water question, they have avoided all risk to themselves by simply creating a Water Board to do the work. The Board may propose what it pleases, and Parliament can say aye or nay as it chooses. Neither the initiative nor the result will affect the Government. The only difficulty is in getting the Board into existence. The County Council are not likely to be satisfied with sixteen members out of thirty. Their desire is to possess the water supply for themselves, or in a slender alliance with the Corporation. But the dream may as well be dismissed. The water question has outgrown the County Council, as London has outgrown its ancient limits, except that the process has been especially rapid in the former case."

"Engineering" says it really appears that, "after more than a quarter of a century's argumentation, disputation, and abortive legislation, the Metropolis is likely at last to have the water question settled within reasonable limits of time. London, in regard to water, is an ungrateful city. It has enjoyed for a longer period than any other large community an excellent artificial water supply; excellent even when judged by the high standard that is now demanded. This London owes to the enterprise of the never-to-be-sufficiently abused capitalist, who risked, and often lost, his money freely in times past to lay down pipes and erect pumps. Had it not been for these adventurers, whose successors some of our very advanced politicians are so anxious to despoil, the Metropolis would not have been the healthy city it has become; and, indeed, if the duties entrusted to municipal corporations and other elected public bodies had been as well carried out as the supplying of water, London might have been spared much illness and discomfort in times past. However that may be, the 'rule of the monopolist' is, we are told, now past; and shareholders in the London Water Companies are informed they must think themselves fortunate in getting compensation for clearing out. Recognizing, then, that the 'monopolist' must pass away, the Bill introduced by Lord James of Hereford, on behalf of the Government, in the House of Lords, is the most hopeful step yet taken towards vesting the water supply in a public body. It deserves support, if only from the fact that it will prevent the London County Council becoming a monopolist in its turn, and perhaps a more tyrannical taskmaster than the most reckless water company has ever been."

"London," as a matter of course, does not like the Bill; and it sees "no reason why anyone who is not animated by a desire to belittle the County Council, or is interested by self-interest, should support it." The writer considers that, "as an attempt to grapple with a great problem, it is a failure." The following are our contemporary's objections to the proposed Water Board: "(1) We are opposed to the creation of such a Trust on the ground that the Government has no mandate for its policy. A Water Trust has not been asked for by any public body, or by the water consumers. (2) It will not satisfy the vast majority of water consumers inside and outside London, and is not fairly constituted. (3) It will cause constant friction, and will mean unnecessary expense. (4) It does not, even if the Government scheme would work harmoniously, and prove practicable—and we hold that it would not—solve the water problem, but adds to present difficulties."

The writer of the "Unofficial Minutes" in the "Local Government Journal" says: "It is all very well to talk about taking over the water supply, and objecting to monopolize the free gift of Nature. But the question is a very serious one; and the point is, How much better shall we be if the Water Companies are bought up, and the supply placed in the hands of a Water Trust? Shall we not risk flying from those ills we have to those we know not of? At present, ordinary consumers find they have sufficient water for their ordinary use; and the charge for it is not very excessive. True, there are the questions of baths and high service, which are objections; and the Water Companies would be wise if they abolished these extra charges, seeing that they make a good profit out of their undertakings. Should we pay any the less if we had a Water Trust, composed not of capable business-like directors, but theorists?" But elsewhere in the paper it is suggested that it would have been better, granting the necessity that the water supply should be in the hands of the public, for the Government to have "provided for the purchase right out of the Companies on the basis of a fair valuation, and then to have handed over the control of the eight undertakings to eight distinct Water Boards, the members of which should be elected on a franchise which should give every householder a vote, by means of voting-papers delivered and collected at each house—the principle of the cumulative vote being admitted in order that all districts should be fairly represented."

Additional Capital for the Chertsey Gas Company.—For the 160 shares (£25) for which the Chertsey Gas Company recently invited tenders, 331 applications were sent in. The reserve price was £40; and the shares were allotted at £44 each—the average offer.

LANCASTER CORPORATION WATER SUPPLY.

The Local Government Board and the Blea Tarn Scheme.

Last Friday, an inquiry was held at Lancaster by Colonel Durnford, on behalf of the Local Government Board, respecting an application by the Corporation to borrow £65,000 for the construction of a storage reservoir at Blea Tarn. An inquiry was held into the subject in February of last year by the Board, when all the details were gone into. On that occasion, the Local Government Board urged upon the Corporation the advisability of making use of the Manchester water supply; while the Corporation maintained the advantages of their own scheme, both from an engineering and financial standpoint. A Provisional Order to carry out the work was applied for by the Corporation; and this passed through both Houses of Parliament, receiving the Royal Assent in September last. When, however, the Corporation applied to the Local Government Board for sanction to borrow the £65,000 authorized by the Order, the Board again pressed the claims of the Manchester source of supply; and deputations who waited upon the Board failed to get them to see that to reopen the question would be to go beyond the Order. The Local Government Board, however, directed an inquiry to be held. Mr. Cook, the Borough Water Engineer, explained the scheme, showing the suitability of the Blea Tarn site as a reservoir to hold 100 million gallons, which would serve not only as a storage, but as a service reservoir. It was necessary to store water now, because for thirty-three consecutive nights in a dry season the water had been shut off from the town, while at other times water was running to waste. Mr. Strachan, Assistant to Mr. J. Mansergh, commended the scheme, and dealt exhaustively with the suggestion of the Local Government Board. He said that the cost of the Manchester water would be a fraction less than 9d. per 1000 gallons; and the level of their line of pipes would necessitate the construction of a reservoir for storage, as well as a line of pipes in addition to those already existing to get the water to the town. This would involve a capital outlay of at least £30,000, in addition to the 9d. per gallon. The Lancaster Corporation, under their scheme, could supply water at 6d. per 1000 gallons; and they were compelled by Act of Parliament to supply it at that price to places in the vicinity. Therefore it would saddle the town with heavy financial burdens if they had to take the Manchester water. They wanted power to store the water now running to waste, which they had parliamentary power to take. If at any future time it was necessary to tap the Manchester line of pipes, the present works would be utilized. The Inspector, in the course of the proceedings, remarked that, if a storage reservoir was required for the Thirlmere water, it put an end to the Manchester case.

Reductions in Price.—The Southend Gas Company have reduced their price from 4s. to 3s. 10d. per 1000 cubic feet. The Minster Gas Company have decided to make a reduction in the price of gas used for public lighting purposes, from 4s. to 3s. 9d. per 1000 cubic feet, from the 25th inst.

The Result of "Divining" for Water at Richmond (Surrey).—At the meeting of the Richmond Town Council on the 10th inst., the Engineer (Mr. W. G. Peirce) reported that during the preceding four weeks the workmen had been engaged boring in the adits (at various places indicated by Messrs. Mullins and Gataker, whose services as "diviners" had been called in) 409½ feet in all—viz., 13 bore-holes completed and in hand, varying from 10½ to 125 feet in depth, yielding 220 gallons of water per day. Mr. Mullins estimated 1500 gallons per day, and Mr. Gataker 30,000 gallons per day, at the places selected and depths bored during the past month. Six feet of adit driving in the north-east adit had been completed, and a bore-hole put down to the depth advised by Mr. Gataker, but without any result at all as regards an increase of water.

East Huntingdonshire Water Supply.—Last Wednesday, Colonel Yorke, R.E., one of the Board of Trade Inspectors, held an inquiry into the application made by the East Huntingdonshire Water Company for a Provisional Order to enable them to extend their area and construct a new pumping station in the chalk near Royston, to convey water into an area in Huntingdonshire and Cambridgeshire having a population of 40,000. Lord de Ramsey and others were called, besides numerous expert witnesses on either side, as to the effects upon the district from which the water is to be taken. Lord Robert Cecil appeared for several local bodies, including the Royston Water Company, in opposition to the scheme; and the Hertfordshire, Cambridgeshire, and Isle of Ely County Councils were also represented. The opposition was directed against the absence of any *bonâ fide* public demand for the scheme, and to it being intended more for the financial improvement of the Company than to supply a public necessity.

The Chester Corporation Sluices Bill and the Water Supply.—Since the publication of Dr. Bruce Low's report on the condition of the River Dee, from which the water supply of Chester is derived, there has been a formidable opposition to the Corporation Sluices Bill, by which power is sought to execute works which have for their main object the prevention of the pollution of the river in the neighbourhood of the Water Company's intake. Altogether 22 petitions have been filed against the Bill; but at the last meeting of the Council, Alderman Churton made light of these, and said that many of them "would fade away like frost on a window pane when the morning sun shone out." He also pointed to the urgent necessity for the Bill; and expressed his firm belief that it would pass. He was satisfied, after an interview with the Local Government Board and their principal Medical Officer (Dr. Thorne Thorne), that the department were distinctly friendly to their proposals; and suggestions had been made to the Fishery and Conservancy Departments of the Board of Trade which, he believed, would remove all difficulty in that quarter. From a local paper, we learn that the Water Company are also antagonistic to the scheme. The Engineers of the two bodies, however, have met, and come to an understanding which may result in their withdrawal of opposition.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Two matters occupy my attention chiefly this week—the resolution by the Edinburgh and Leith Gas Commissioners to adopt carburetted water gas; and the issue by Mr. A. Vernon Harcourt of his report upon the explosion in the Forfar Corporation Gas-Works.

As to the former, the Commissioners have only made up their minds after nearly three years' consideration of the subject, during which time they have exhibited a vacillating policy of which it would be difficult to find the equal. They have changed their minds so often, that there is even now no guarantee that they may not do so again, and go back from their resolution of Monday last. I wrote the other week that the time would come when the Commissioners would see eye to eye with me. I do not despair of that yet. Events are moving in a direction of which probably the Commissioners are unaware. When these have advanced a little further, the Commissioners will probably wonder at their not perceiving the development. At any rate, they have made up their mind to introduce Messrs. Humphreys and Glasgow's plant into the Edinburgh works. In the meantime, I shall offer no further criticism on their action, but shall wait events.

There is, however, opportunity, if not necessity, for saying something upon the reports of Professor Crum Brown and Mr. J. Stenhouse, given on another page of the "JOURNAL;" and the more so because, from the eminence of the Professor in matters relating to chemistry, there is every probability that his report will be regarded as a standard work. It is rather an epoch-making production. Hitherto the analyses of Dr. Percy F. Frankland have, I understand, been looked upon as the most authoritative upon the composition of gases. During the years 1882 to 1884, he made most exhaustive investigations into the composition of the gas supplied in twenty of the large towns in the kingdom—of course, pure coal gas in all cases. The results he embodied in a table, which he submitted to the Society of Chemical Industry, and which was published in their "Journal." He found in the gas which was being supplied in Edinburgh 6·61 per cent. of carbonic oxide; in the case of Glasgow, 7·14 per cent.; in London, 3·75 and 4·14 per cent.; and that the average of all the twenty samples was a little over 4 per cent. With regard to his table, Dr. Frankland remarked: "I have repeatedly heard it stated, even quite recently, that carbonic oxide is usually present to the extent of about 10 per cent. in coal gas. Now that is certainly not the case, for I have never yet examined a sample of gas containing that amount. It would be much nearer the truth to say that the proportion of carbonic oxide usually varies from 3 to 5 per cent." Now, Professor Crum Brown gives the average quantity of carbonic oxide present in Edinburgh gas of the present day as 11 per cent.; and Mr. Stenhouse states it at nearly 10 per cent. What is the explanation of this extraordinary rise in the proportion of carbonic oxide? Of course, it must have been found in the gas, or it could not have been reported as present. Is it a change in the coal, or in the method of working? The question naturally arises whether the percentage has increased in other places, because, if so, the way for the introduction of carburetted water gas, with its high percentage of carbonic oxide, would be naturally made much easier thereby. It would be one thing to increase from 4 to 20 or 22 per cent., and quite another to increase from 10 or 11 to this amount. A more extraordinary change in composition seems to be set up by Professor Crum Brown, in respect to the proportion of carbonic oxide to hydrogen in carburetted water gas. On this subject, Mr. A. G. Glasgow, as one of the owners of the process about to be introduced into Edinburgh, might be expected to have some knowledge. When taking part in a discussion at a meeting of the Incorporated Institution of Gas Engineers in May, 1893,* he said: "A glance at the Lowe column in the table, shows the analysis of this gas to be incorrect. By the principle of its manufacture, it is impossible for the gas to contain as much carbon monoxide as hydrogen. Perfect conversion of the steam yields equal volumes of hydrogen (H_2) and carbon monoxide. But, as a certain proportion of carbon dioxide is invariably formed, reducing in twofold ratio the volume of carbon monoxide, and, further, since the gasification of the oil always liberates a considerable quantity of hydrogen, it is invariably found that a gas containing this 29 per cent. of carbon monoxide will have 35 to 38 per cent. of hydrogen." Turning to Professor Crum Brown's report, it will be found that he gives, in the first sample of gas taken at "*B*," 30·1 per cent. of carbon monoxide, and only 28·7 per cent. of hydrogen. In his second sample, he states carbon monoxide in one case at 32·0 per cent., and hydrogen at 28·2 per cent.; and in the other, carbon monoxide at 32·1 per cent., and hydrogen at 28·8 per cent. Mr. Stenhouse gives the proportions as 30·0 and 30·7 per cent. of carbonic oxide, to 19·9 and 18·0 per cent. of hydrogen respectively. Which of these is to be taken as the authority in future? They cannot both be right. The two examples I have given are such an upsetting of accepted theories, that I consider it desirable to point them out, in order that in fundamental matters of composition—which should, at this time of day, be as fixed as the multiplication table—there should be no disposition among gas chemists to drift. It is highly essential that there should be an undoubted authority on the subjects mentioned; and Professor Crum Brown's report being now public property, and likely to be made use of, I trust that someone will take the matter up, and endeavour to have the figures he gives either affirmed or corrected.

On other matters, the report speaks for itself. It establishes quite clearly that, when employed under ordinary conditions, the use of carburetted water gas is quite safe. Everybody knew that; what was in doubt was whether conditions might not arise in which there would be danger. The report stops short at that; but this was on account of the remit to Professor Crum Brown having been restricted. The other questions, relating to distribution, are more matters of engineering. To this, there is no direct reference; but there is an approach to it, in the mention of the experiment in a room containing 3300 cubic feet space. The test is said to have been a severe one; and so it was, so long as only smell was being sought for. As to safety, it was the very opposite of severe. There are few sleeping apartments so large as the one experimented with. Take a room 10 ft. by 10 ft. by 9 ft.—and there are many much smaller—the capacity of it would be 900 cubic feet. Suppose a family of five persons sleep in this room, and the atmosphere gets vitiated by the breathing of the inmates, if by either accident or carelessness, gas were allowed to enter the room, how long would it take to create the poisonous mixture of 1 in 500? Experience may furnish the answer.

The Commissioners accepted the report unanimously; and it required little persuasion from Bailie Kinloch Anderson to get them to approve of the proposal to enter into a contract with Messrs. Humphreys and Glasgow, who are now the only offerers; the Economic Gas Apparatus Construction Company having withdrawn. Among other items before the Commissioners, was their agreement to pay Professor Crum Brown a fee of 200 guineas for his report. The Commissioners' dinner in the evening was a very pleasant gathering.

Mr. Vernon Harcourt's report to the Board of Trade regarding the explosion in the Forfar Gas-Works, was received in Forfar on Thursday. I have not yet seen the report, but only a newspaper summary of it.* As to the immediate cause of the accident, Mr. Harcourt appears to entertain no doubt; it was pressure of gas in the hydraulic main, which drove the liquor and tar up into the dip-pipes which were not connected with the charged retorts, till gas could make its way past the bottom of the dip-pipes, and out into the air by the open lids of the retorts. He thinks that the Manager committed an error of judgment in opening the lids of the retorts not in use, when he was aware that there was a back-pressure which was sending gas down the ascension-pipes. He makes several recommendations with reference to the seal of the hydraulic main. A special meeting of the Gas Corporation is to be held to consider the report. As I have not yet seen the report itself, I do not feel at liberty to make any comment upon it.

The contracts for the extensive new retort-houses and coal-stores at the Tradeston works of the Glasgow Corporation have been let. The excavating, brick, and masonry work is to be done by Messrs. John Paterson and Son, Limited, of Glasgow, at the price of £5497; and the ironwork is to be provided by the Brandon Bridge Building Company, Limited, at a cost of £4652.

The Greenock Police Board on Tuesday considered a report by Mr. S. Stewart, the Gas Manager, relative to the proposed extension of the retort-house and mains. The report stated that during January nearly every retort in the place was employed; and had the foundries in the town been in full work, or had any of the retorts broken down, it was doubtful if the plant would have been equal to the demand, without the aid of high-priced cannel. To meet the present and increasing demand, Mr. Stewart recommended the erection of six ovens of eight retorts each, on the Klönne system, which would be equal to producing nearly half a million cubic feet of gas per 24 hours. Mr. Stewart is satisfied that, at the conclusion of the financial year, it will be found that the Peebles process of manufacturing gas from oil has been an economical method of enriching the gas. They had now overcome some initial difficulties; and the men understood the working of the system. Should the Board resolve to increase the oil-gas manufacture, he would recommend the erection of six additional iron retorts for this purpose. The cost would be: Coal-gas retorts, £2000; oil-gas retorts, £500; mains, £530—making in all £3030. A Sub-Committee was appointed to further consider the subject, and to report.

The Sub-Committee of the Glasgow Corporation who are considering the subject of the lighting of the streets by electricity have visited Blackpool, Brighton, and Portsmouth, and seen the methods of street lighting in use in these places, besides getting information as to prices and other arrangements. Since returning, they have resolved to ask the students of the School of Art and the School of Design to furnish them with designs for a wrought-iron bracket for the existing lamp-pillars, to render a pendant lamp possible; and, in order to throw interest into their request, they have agreed to offer a small premium. This will not go far to improve the lighting; but there is a talk of transferring the supply of current for the street-lamps from the John Street to the Waterloo Street station, and to give the supply from the low-tension system, instead of the high-tension as at present. By this means, it is expected that about £640 a year will be saved, and that the charge per lamp may be reduced to £22 per annum.

The Corporation of Paisley, who obtained a Provisional Order in 1891 empowering them to lay down electric lighting plant in the burgh, have resolved to put the Order in force by providing current within a radius of one mile from the old prison buildings, a portion of which is to be converted into a central station. Under the Order, the Corporation were required to provide electric light within a restricted area in two years; but, though they have not done so, the Order has not been revoked. This tardy resolution to proceed may be taken as intended to warn off some enterprising marauders.

The Falkirk and District Water Bill has passed the House of Lords Committee as an unopposed measure. When first lodged, opposition was threatened by mill owners on the Carron River; but, the question between them and the Water Trust being merely with regard to compensation water, an agreement was come to. The only opponents left were the County Council of Stirling, who wished to have two villages, one on each side of the district of compulsory supply, included in the area. The object of this was to enable the County Council to get a supply of water at a lower rate than is charged to districts outside the compulsory area. The House of Lords Committee refused the County Council *locus standi*. The Council are, however, likely to appear before the House of Commons Committee; and their chances are supposed to be more hopeful there.

An addition to the water supply of Dunbar was inaugurated last Saturday. The necessity for a better supply arose in consequence of an outbreak of typhoid fever in the end of last year. No fewer than 101 cases, and 12 deaths, occurred in a community numbering 3700 persons. It was found that the water supply was contaminated at the intake. The new supply has been taken from a source further afield, and has cost £3000. The old water system has been utilized so far as possible. It is estimated that the supply will now be double the amount required by the community.

* See "JOURNAL," Vol. LXI., p. 943.

* The full report appears elsewhere to-day, p. 649.—ED. J.G.L.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *March* 21.

Sulphate of Ammonia.—The tone of the market is weaker; and closing quotations are £8 6s. 3d. to £8 7s. 6d. f.o.b. at the ports. The volume of direct export demand has been disappointing; and there has been a marked absence of buying by dealers. It may be that some considerable "covering" of sales for March delivery has still to be done; but, if so, buyers have not so far given any indication of it. There continues to be a fair demand for home consumption; but there has been some falling off in this, owing no doubt to the less favourable weather retarding agricultural operations. In the forward position, sellers are becoming more daring; but buyers, influenced by the weak spot market, will not now operate ahead, unless at somewhere near prompt prices.

Nitrate of Soda.—This market is also quieter, although spot price remains at 8s. per cwt. for good up to 8s. 1½d. per cwt. for fine quality. The effect of the combination of producers was fully discounted on the market long before the combination was formally confirmed; and if there should be a spell of unfavourable weather, some reaction is by no means out of the question. Due cargoes are worth about 7s. 10½d. ordinary quality.

LONDON, *March* 21.

Tar Products.—A fair business is being done in most products; but prices, generally speaking, are comparatively low. The better feeling noted in benzols last week is continued; and the important sale of a large quantity of 90's at 1s. 10½d. by one of the best makers has accentuated the position—buyers being now willing to pay a small advance in price, as well as to purchase for the second half of the year. Anthracene is reported to be lower in price, although there is undoubtedly a steady market for it. A large sale of "A" quality at 10½d. has, for the moment, taken the wind out of the sails of the Tar Products Sales Committee, whose official quotation is 1s. for "A" anthracene. Steady and important business is being done in carbolic acid. The advent of a new buyer has produced a marked influence on this market. Carbolic acid makers have not been so free of stocks for many years as they are to-day. Pitch is weak; and buyers are waiting for the appearance of lower prices. Some sales have been made for South Wales at prices which would leave makers much below the following quotations.

Average prices during the week are: Tar, 18s. to 22s. 6d. Pitch, 31s. 6d. to 34s. Benzols, 90's, 2s. 1d.; 50's, 1s. 8d. Toluol, 1s. 6d. Solvent naphtha, 1s. 2d. to 1s. 3d. Crude, 30 per cent., naphtha, 10d. Creosote, 1d. Naphthalene salts, pressed, 50s.; drained, 27s. 6d. Cresylic acid, 1s. 2d.; brown, 10½d. Carbolic acid, 60's, 2s. 3d. Anthracene, "A," 10½d.; "B," 9d.

Sulphate of Ammonia continues in a wretched condition. Notwithstanding reports of shorter shipments of nitrate, this market continues sick and languid. Business has been done during the week at: Beckton, £8 5s.; Beckton terms, £8 3s. 9d.; London, £8 7s. 6d.; Hull, £8 7s. 6d.; Leith, £8 6s. 3d.—all less 3½ per cent. Gas liquor is offered at 6s. to 7s. per ton.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The position in the coal trade here remains much as last reported; business generally continuing only very moderate, with many pits not running more than four days per week. Prices for house-fire coals are barely maintained at late rates. It is only in exceptional cases that more than 10s. per ton at the pit is being obtained for best Wigan Arley; 8s. to 8s. 6d., for seconds Arley and Pemberton four-feet; and 7s. for common house coals. Notwithstanding the increased activity in the iron trade and other branches of industry, the demand for common round coals continues far below the output, with excessively low prices ruling; this branch of trade being so unremunerative that colliery owners are restricting their production in every possible way. For good ordinary steam and forge coals, 6s. per ton at the pit remains about the average figure. A continued hardening tendency is noticeable as regards engine fuel. The better qualities are becoming less plentiful with the decreasing demand for house coals; and although any materially higher prices are difficult to get, colliery proprietors will not contract forward, except at some advance upon current rates. At the pit mouth, the better qualities average 4s. 6d. up to 5s. per ton for some special sorts, with common descriptions ranging from 2s. 9d. up to 3s. 3d. The shipping trade continues quiet, with very low prices ruling. Common steam coal, which is sold for bunker purposes, is in many cases not fetching more than 5s. to 5s. 3d. per ton at the pit, which represents about 6s. 6d. to 7s. delivered at the ports on the Mersey; while really good qualities scarcely average more than 7s. 9d. per ton.

Northern Coal Trade.—There has been a little more movement in the coal trade of this district in the last few days; and the settlement of a number of large contracts for gas coal has taken place. Best Northumbrian steam coals are in a little better demand; and the chief collieries are now beginning to have rather fuller work, though still below that which is normal. The price quoted for best steam coals is still 7s. 9d. per ton f.o.b.; second-class steam, 7s. to 7s. 6d.; and steam smalls, about 3s. 6d. Competition is keen for such orders as are in the market. Generally, the quotation is 10s. per ton f.o.b. Manufacturing coal is steadier in the demand; but there is no alteration of moment in the price this week. In gas coals, the contracts for the South Metropolitan Gas Company, which aggregate over 700,000 tons yearly, have been closed; and while there has been no official statement as to the prices, it is believed that for the next year's supply the rate is 6s. 3d. per ton f.o.b. A slightly higher price is to be paid in one or two cases where the contract is to be carried into a second year. A large Italian contract for gas coal has also been concluded; and one for the supply of Rotterdam is expected to allow a portion of the coal to be taken from this district, but at a price believed to be very low, though the exact yield to the coalowner will depend upon what may be considered to be the probable rate of freight. In the coke trade, there is increasing activity; and the larger production is well taken up. The quotation is now about 13s. 9d. to 14s. per ton for local blast furnaces. The export coke trade is steady, the f.o.b. price being now 14s. 9d. to 15s. per ton; and a larger demand is expected when the northern navigations are open. Gas coke is now less in stock than it has been; and there is a fair request for it for manufacturing purposes, though the exports are moderate. The prices of gas coke show no alteration generally.

Scotch Coal Trade.—In Scotland there is no change to report. Inquiry is still greatest for the small varieties; and, indeed, it is so large that, screened coal being of limited output, there is scarcely sufficient small to meet the demand. There is, however, a fairly large business being done; but prices are unaltered. The quotations are: Main, 5s. 9d. per ton f.o.b. Glasgow; ell, 6s. 6d. to 6s. 9d.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. The shipments for the week amounted to 104,742 tons—a decrease of 15,133 tons on the preceding week, and of 13,629 tons on the corresponding week of last year. For the year to date, the total shipments have amounted to 1,220,759 tons—an increase of 135,303 tons over the quantity in the same period last year.

Water Profits at Dover.—The Dover Town Council have ordered the transfer of a credit balance of £2278 to the general district fund; this sum (which is about equal to a rate of 3d. in the pound) being the profit on the supply of water.

New Water Reservoir for Neath.—The Neath Town Council have accepted a tender of Mr. James Allan, of Cardiff, amounting to £12,825, for the construction of a new storage reservoir, which forms part of their new water-supply scheme.

Abingdon Gas Company.—At the recent half-yearly general meeting of this Company, the Directors reported receipts to the amount of £2432 in the six months ending Dec. 31 last; and an available balance of £1039. Dividends of 5 and 3½ per cent. on the original and new shares were declared. In acknowledging a vote of thanks, the Chairman (Mr. Alderman Townsend) said he had not missed an annual or half-yearly meeting during the 35 years he had been connected with the Company. He proposed a hearty vote of thanks to Mr. Ely, the Secretary and Manager, whom he always found at his post, and who on all occasions was ready to do his best for the Company. Mr. Challenor, in seconding the proposition, bore testimony to the painstaking way in which Mr. Ely discharged his duties. Mr. Ely having acknowledged the compliment, the meeting terminated.

Exmouth Gas Company.—At the annual general meeting of this Company to be held next Tuesday, the Directors will report that the total receipts on revenue account for the past year were £4933; while the expenditure was £3496—leaving a balance of £1437. This added to the undivided balance makes a total of £1951 to the credit of the profit and loss account; and the Directors will recommend dividends of 10 and 7 per cent. on the three classes of shares. This will absorb £640; and leave £1311 to be carried forward. The Directors congratulate the proprietors on the prosperity of the Company, which has enabled them to make a further reduction of 3d. per 1000 cubic feet in the price of gas from Dec. 31 last, both for public and private lighting; bringing the rate down to a uniform one of 3s. 6d. Extensions of the works are contemplated in the ensuing summer, which will necessitate increasing the capital by about £1500.

The Coal Dues at Bognor and the Price of Gas.—At the meeting of the Bognor District Council last Wednesday week, Mr. Lovett brought forward a proposal that the coal dues should be abolished, if this could be legally done. He urged that their abolition would not hurt anyone, while the ratepayers generally would derive an advantage. On the old assessment, the dues were tantamount to 8½d. in the pound on the rates. The town, however, was on the verge of a great change in the assessment; and when this was altered, the dues would only be equal to 4½d. in the pound. If they were abolished, the townspeople would benefit from the fact that the Gas Company with which he was connected, who now paid £200 a year in coal dues, would probably reduce the price of gas by about 3d. per 1000 cubic feet. Another advantage might, he said, be looked for in consumers being supplied with a better description of coal. The matter is to be referred to a Special Committee.

Wrexham Gas Company.—The annual general meeting of this Company was held on the 18th inst.—Mr. J. Oswell Bury in the chair. The Directors reported that there had been in the past year an increase of £1166 in the receipts for gas supplied; but a decrease of £327 on the residuals sold. They had made a reduction in the price of gas supplied to the Corporation for the public lamps by allowing an additional discount of 3d. per 1000 cubic feet; they had also announced a reduction of 6d. per 1000 cubic feet to users of gas exclusively for motive power. They trusted these concessions would lead to an increased consumption of gas. They recommended the usual dividends—viz., 5 per cent. on the consolidated stock, and 3½ per cent. on the shares; making with the interim dividend paid in September last, 10 and 7 per cent. respectively. The Chairman moved the adoption of the report. The motion having been seconded by the Vice-Chairman (Mr. W. Overton), Mr. H. Croom Johnson supported it in a speech in the course of which he gave some interesting figures to show that the success achieved in the past year had been due to a large extent to keen supervision on the part of the Directors and management. He said the value of the gas sold in 1895 was £1166 more than that of the quantity sold in 1894. In other words, they had earned about 3s. 4d. per ton more out of the coal carbonized in 1895 than they did in the preceding year. Their profit had been earned at a less cost. They would have been justified in spending £7315 to get the profit they had earned; whereas they had spent £106 less than this. There had been £98 more spent in 1895 than had been laid out in 1894 for repairs and maintenance of works and plant; so that they would be entitled to add that £98 to the £106. In other words, they would have been justified in spending £7413 in 1895 to earn their profit; whereas they had only spent £7209—a saving of £204. The report was adopted, and the dividends recommended were declared.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 618).

Issue.	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	24½—25½	+½	4 2 4
100,000	10	„	7½	Do. 7 p. c.	17—18	..	4 3 4
300,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	108—110	..	4 10 11
200,000	10	16 Oct.	4	Belgrano (B. Ayres), Limited	8½—9½	..	4 4 3
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	95—100	..	5 0 0
200,000	5	14 Nov.	6½	Bombay, Limited	7½—7¾	..	4 3 10
40,000	5	„	6½	Do. New, £4 paid	5½—5¾	..	4 10 3
380,000	Stck.	27 Feb.	12	Brentford Consolidated	280—285	..	4 4 3
210,000	„	„	9	Do. New	215—220	..	4 1 9
50,000	„	„	5	Do. 5 p. c. Pref.	—	..	—
159,375	„	16 Dec.	4	Do. 4 p. c. Deb. Stock.	127—132	..	3 0 7
220,000	Stck.	27 Sept.	11	Brighton & Hove Original	230—235	..	4 13 8
208,820	„	„	8	Do. A Ord. Stk.	185—190	..	4 4 3
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	123—126	..	3 19 4
420,000	20	27 Sept.	11½	British	55½—56½	..	3 19 7
50,000	10	12 Mar.	11½	Bromley, Ordinary 10 p. c.	22½—23½†	..	4 17 10
71,000	10	„	8½	Do. 7 p. c.	19—20†	..	4 5 0
500,000	10	14 Nov.	4	Buenos Ayres (New) Limited	9½—10	..	4 0 0
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	102—104	..	5 15 5
150,000	20	27 Feb.	8½	Cagliari, Limited	29—31	..	5 6 5
100,000	10	27 Sept.	6	Cape Town & District, Ltd.	12½—13½	..	4 8 10
50,000	50	2 Nov.	6	Do. 6 p. c. 1st Mort.	57—59	..	5 1 9
550,000	Stck.	16 Oct.	13½	Commercial Old Stock	332—337	+2	4 0 2
165,000	„	„	10½	Do. New do.	257—262	..	4 0 3
165,000	„	16 Dec.	4½	Do. 4½ p. c. Deb. do.	147—152	..	2 19 2
800,000	Stck.	16 Dec.	13	Continental Union, Limited.	278—283	..	4 11 10
200,000	„	„	10	Do. 7 p. c. Pref.	215—220	..	4 10 11
51,600	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
157,500	„	„	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5½	Crystal Palace Ord. 5 p.c. Stk	130—135	..	3 17 9
60,000	„	„	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	30 Jan.	11	European, Limited	26½—27½	..	4 0 0
354,060	10	„	11	Do. £7 10s. paid	17⅛—18⅛	..	4 9 3
5,746,590	Stck.	13 Feb.	12¾	Gaslight & Coke, A, Ordinary	290—295	−11½	4 6 5
100,000	„	„	4	Do. B, 4 p. c. max.	108—113	..	3 10 9
665,000	„	„	10	Do. C, D, & E, 10 p. c. Pf.	288—293	..	3 8 3
30,000	„	„	5	Do. F, 5 p. c. Prf.	140—145	+5	3 9 0
60,000	„	„	7½	Do. G, 7½ p. c. do.	205—210	+5	3 11 5
1,300,000	„	„	7	Do. H, 7 p. c. max.	200—205	+3	3 8 3
463,000	„	„	10	Do. J, 10 p. c. Prf.	287—292	+2	3 8 6
476,000	„	„	6	Do. K, 6 p. c. Prf.	168—172	..	3 9 8
1,061,150	„	16 Dec.	4	Do. 4 p. c. Deb. Stk.	138—142	+1½	2 16 4
294,850	„	„	4½	Do. 4½ p. c. do.	148—153	..	2 18 9
908,000	„	„	6	Do. 6 p. c. do.	204—209	..	2 17 5
70,000	10	30 Oct.	6	Hongkong & China, Limited	13—14	..	4 5 8
3,800,000	Stck.	14 Nov.	12	Imperial Continental	247—252	−1	4 15 3
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100—103	..	3 17 8
473,600	Stck.	13 Feb.	3½	Do. 3½ p. c. Deb. Stk	108—110	..	3 3 8

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	16 Dec.	6	Malta & Mediterranean, Ltd.	6—6½	..	4 12 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	115—118	..	4 4 10
250,000	100	„	4½	Do. 4½ p. c. Debs.	109—111	..	4 1 1
541,920	20	14 Nov.	5	Monte Video, Limited	16½—17½	..	5 14 3
150,000	5	28 Nov.	8	Oriental, Limited	8½—8¾	..	4 11 5
135,000	5	„	8	Do. New, £4 10s. paid	7½—7¾	..	4 12 10
15,000	5	„	8	Do. do. 1879, £1 paid	1¾—2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	4¾—5⅛†	..	6 13 4
166,870	10	—	2	Para, Limited	1—1½	−¼	—
420,000	100	2 Nov.	6	People's Gas } 1st Mtg. Bds.	105—110	..	5 9 1
500,000	100	9 Dec.	6	of Chicago } 2nd Do.	100—105	..	5 14 3
250,000	10	16 Oct.	8†	San Paulo, Limited	12½—13½	..	5 11 1
500,000	Stck.	13 Feb.	15½	South Metropolitan, A Stock	387—392	+2	3 19 1
1,350,000	„	„	12	Do. B do.	310—315	..	3 16 2
310,000	„	„	13	Do. C do.	327—332	..	3 18 3
800,000	„	16 Jan.	5	Do. 5 p. c. Deb. Stk.	175—178	..	2 16 2
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250—255*	..	4 10 2
60,000	„	„	8½	Do. B	—	..	—
170,380	10	30 Dec.	10	Tuscan, Limited	13—14	..	7 2 10
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100—102	..	4 18 0

WATER COMPANIES.

746,021	Stck.	30 Dec.	10½	Chelsea, Ordinary	320—325	..	3 3 1
150,000	„	„	5	Do. 5 p. c. Pref.	170—175	..	2 17 1
160,000	„	„	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,785	„	27 Sept.	4½	Do. 4½ p. c. Deb. Stock	155—160	..	2 16 3
1,719,514	Stck.	16 Oct.	7	East London, Ordinary	252—257	−1	2 14 4
654,740	„	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	155—160	..	2 16 3
100,000	„	„	3	Do. 3 p. c. Deb. Stk.	105—107	..	2 16 1
700,000	50	16 Dec.	6½	Grand Junction, 10 p.c. max.	127—132	+2½	2 9 3
280,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	148—152	+2½	2 12 8
708,000	Stck.	13 Feb.	12	Kent	332—337	..	3 11 2
160,000	„	„	7	Do. New, 7 p. c. max.	207—212	+2	3 6 0
1,043,800	100	30 Dec.	7½	Lambeth, 10 p. c. max.	273—278	+1	2 12 2
406,200	100	„	7½	Do. 7½ p. c. max.	225—230	+2	3 3 1
330,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	147—152	..	2 12 8
500,000	100	13 Feb.	12½	New River, New Shares	420—430	..	2 19 3
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	153—158	+1	2 10 8
902,300	Stck.	16 Dec.	6	S'thwk & V'xhall, Ordinary	170—175	−2	3 8 5
126,500	100	„	6	Do. Do. 7½ p. c. Max.	155—165	..	3 12 9
489,200	Stck.	„	5	Do. Do. 5 p. c. Pref.	168—173	..	2 17 9
1,019,585	„	—	4	Do. 4 p. c. A Deb. Stk.	147—152	..	2 12 8
1,155,066	Stck.	16 Dec.	10	West Middlesex	305—310	..	3 4 6
200,000	„	„	4½	Do. 4½ p. c. Deb. Stk.	155—160	..	2 16 3

*Ex div.

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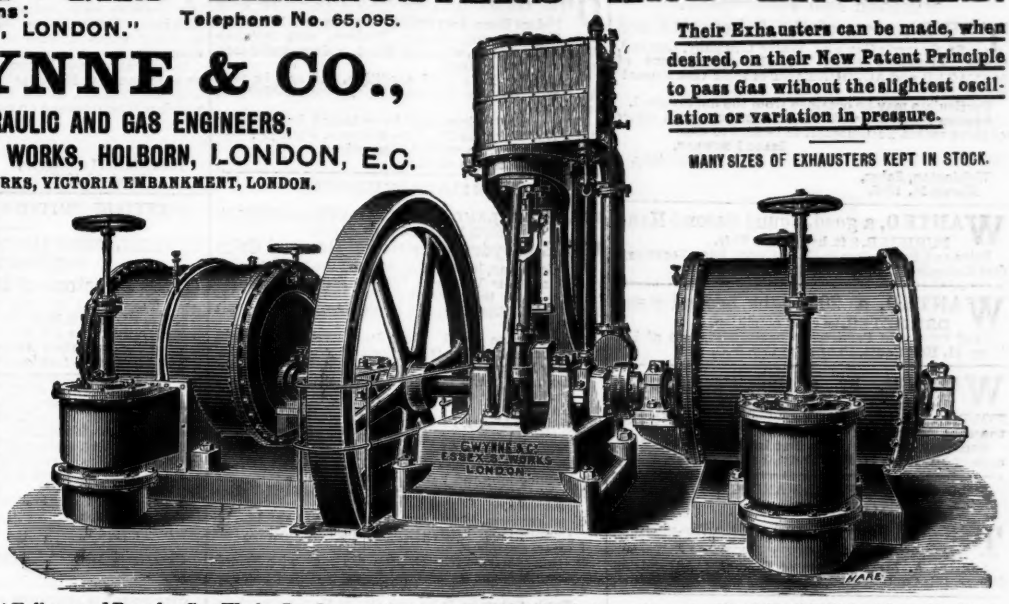

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PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER LINCOLN."

In Paper Covers, Post Free 2s.
STEPHEN CARPENTER, of the Bow Common Gas-Works, on the Purification of Coal Gas by Lime, Oxide of Iron, and Atmospheric Air, and the Method of Working Purifiers so that the Lime may be used a second time, with a description of Carpenter's short Method of working off the Sulphur Test and Table for calculating Results.
S. & H. W. CARPENTER, 3, Bedford Villas, Carshalton, SURREY.

ECONOMY IN PURIFICATION.
INCREASE the Efficiency of your PURIFIERS by adopting CRIPPS'S PATENT BYE-PASS VALVE in the lower Tiers of Sieves. Practical Experience proves their Economy. Engineers are repeating orders after thorough trial.
References and Particulars can be obtained from the Makers—
C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP.
And J. EVERY & SON, Phœnix Iron-Works, LEWES.

SULPHATE OF AMMONIA SATURATORS.
WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.
J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 815, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

It is Worth Your While to Buy DIRECT.
THE RELIANCE LUBRICATING OIL COMPANY SUPPLY on APPROVAL "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Liquids for Gas Making, Enriching, &c.
RELIANCE LUBRICATING OIL COMPANY, WATER LANE, GREAT TOWER, LONDON, E.C.
Depôts at Liverpool, Bristol, Hull, Glasgow, and Newcastle-on-Tyne. Telegrams: "Subastral, London."

TO GAS COMPANIES MAKING SULPHATE OF AMMONIA.
THE Use and Value of Sulphate of Ammonia as Manure—A Leaflet, suitable for Distribution among the Farmers of their respective Districts, by WILLIAM ARNOLD, F.S.I., Land Agent, Rating Surveyor, and Valuer (late Chairman of the Tamworth Gaslight and Coke Company); together with valuable Formulæ, Rotation of Crops and Manures for the same, intended for the use of Tenant Farmers and others interested in Land, and to promote the sale of Sulphate of Ammonia for the production of Corn and other Crops by English Gas Companies.
Prices: 100 Copies, 10s.; 250 Copies, £1 2s. 6d.; 500 Copies, £2; 1000 Copies, £3 15s.
LONDON: WALTER KING, 11, Bolt Court, FLEET STREET.

WANTED, a Situation as Gas-Fitter. Thoroughly acquainted with Fitting-Up Houses for Automatic Supply. Age 22. Unmarried. Abstainer. Good References.
Address L. C. ROWE, High Street, ST. MARY CRAY.

WANTED, a practical Manager for the Sulphate of Ammonia Works in connection with the Govan Iron-Works.
Apply, by letter, addressed "CHEMICAL," 1, Dixon Street, GLASGOW.

WANTED a Man, age 30 to 40, to do Retort Setting and Main and Service Laying, and to make himself useful, in a Country Gas-Works. Wages 30s. per week.
Apply, by letter, with References, to No. 2644, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

REPORTS OF GAS ASSOCIATIONS.
A FEW complete Sets of the Reports OF GAS ASSOCIATIONS from 1883 to 1894, twelve Volumes) may be obtained of the PUBLISHER of the "JOURNAL." *Price 30s., cash with order.* The Volume for 1895 (or single copies of previous Volumes) *5s. 6d. post free.*

CANNEL, COAL, ETC.
JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEWBATTLE, DALKEITH, SCOTLAND.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.
THE LAW GUARANTEE & TRUST SOCIETY, LD.
GUARANTEES FIDELITY.
SEND for complete Prospectus containing Balance-Sheet, Copy of Policy, &c., &c. Mortgage, Debenture, License, and Contingency Insurance.
Head Office: 49, CHANCERY LANE, LONDON, W.C.

HYDRATED OXIDE OF IRON.
PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD

THE Gas Committee of the Leeds City Council invite APPLICATIONS for the post of SUPERINTENDENT of the WORKSHOPS, Comprising the Meter Fixing, Meter Testing, Meter Repairing, and Gas-Stove Departments.
Applicants must have a thorough practical knowledge of the above Trades, and be experienced in the Management of Men.
Salary, £150 per Annum.
Applications, accompanied by not more than three Testimonials, and addressed to the Chairman of the Gas Committee, Municipal Buildings, Leeds, will be received not later than Saturday, the 11th of April.
R. H. TOWNSLEY,
General Superintendent.

TODMORDEN URBAN DISTRICT COUNCIL.
WANTED, an Engineer and Manager for the Gas-Works. Make about 110 million cubic feet.
Applicants should have a knowledge of the Distillation of Tar and other Residual Products, which is carried on at the Works.
Applications to state Qualifications, past Experience, Salary required, and to be accompanied by not more than three Testimonials, and endorsed "Gas Manager," and sent sealed to me before Five p.m., on Tuesday, the 31st inst.
By order,
D. SUTCLIFFE,
Clerk to the Council.
Town Hall, Todmorden,
March 18, 1896.

OAKENGATES AND ST. GEORGE'S GAS AND WATER COMPANY, LIMITED.

MANAGER AND ACCOUNTANT.

THE Directors of the Oakengates and St. George's Gas and Water Company, Limited, invite APPLICATIONS for the appointment of MANAGER and ACCOUNTANT of their Gas Department.

Particulars may be obtained from the undersigned.

Applications, endorsed "Gas Manager," with *copies* of three recent Testimonials to be sent to me.

ISAAC KNOWLES,
Secretary.

Wellington, Salop,
March 16, 1896.

WANTED, a good, Sound Second-Hand PURIFIER, 8 ft. by 10 ft. or 12 ft.

Price and Particulars to G. H. GISBY, Esq., Secretary, Gas Company, Ware, HERTS.

WANTED, a 200-Light Second-Hand DRY METER, in good condition.

Send Price and Particulars to No. 2645, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a Gas Company in Derbyshire, a second-hand Cast-Iron GAS-HOLDER TANK, 50 feet diameter by 20 feet deep (or thereabouts), in good condition.

Replies to be sent, in the first instance, to No. 2646, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS COMPANIES AND CHEMICAL MANUFACTURERS.

TEN good Second-hand, Cylinder-shaped RAILWAY OIL-WAGGONS FOR SALE.

Address A. MARTIN, care of Dawson's Advertising Offices, 161, Cannon Street, LONDON, E.C.

GAS PLANT FOR SALE.

THE Castleford and Whitwood Gaslight and Coke Company have FOR SALE 27 MOUTHPIECES, 19 in. by 15 in., 10 ditto 20 in. by 15 in., ASCENSION and H-PIPES, DIP-PIPES (5-inch), LIDS, &c., Small EXHAUSTER (10,000 feet), 8-inch BYE-PASS and VALVES.

Any other Particulars may be obtained on application to the Manager, Mr. J. NICHOLSON.

ON SALE, for immediate removal—

One GASHOLDER, 40 feet diameter, 14 feet deep, with Columns and Girders complete.

One GASHOLDER, 30½ feet diameter, 11 feet deep with Columns and Girders complete.

Also a quantity of RETORT-FITTINGS, including MOUTHPIECES, LIDS, ASCENSION-PIPES, H-PIPES, and HYDRAULIC MAINS.

For further Particulars, apply to G. E. SAVILLE, Engineer, Gas-Works, TODMORDEN.

GAS PLANT FOR IMMEDIATE SALE.

THE Willenhall Gas Company, having discontinued the Manufacture of Gas at their Works in Lower Lichfield Street, Willenhall, Staffordshire, have the following GAS PLANT for Sale, viz.—

TELESCOPIC GASHOLDER. Outer Lift, 45 ft. by 18 ft.; Inner Lift, 43 ft. by 18 ft. Cast-Iron Columns. Capacity, 58,890 Cubic Feet.

Two TELESCOPIC GASHOLDERS. Outer Lift, 60 ft. by 18 ft.; Inner Lift, 58 ft. by 18 ft. Cast-Iron Columns. Capacity of each, 94,425 Cubic Feet.

STATION METER, to pass 15,000 Cubic Feet per hour; 10-inch Connections. Hydraulic Valves by J. & J. Braddock.

WASHER (Kirkham, Hulett, and Chandler), to pass 250,000 Cubic Feet per day; 8-inch Connections.

ANNULAR CONDENSERS (Walker), to pass 250,000 Cubic Feet per day; 12-inch Connections.

GOVERNOR, 12 inches diameter, with 12-inch Connections, and Bye-Pass, by J. & J. Braddock.

Five Ton WEIGHBRIDGE; two EXHAUSTERS (by Jones), to pass 8000 Cubic Feet per hour; 15 by 16 inch MOUTHPIECES (Morton's Patent); ASCENSION-PIPES, &c.

For further Particulars, apply to J. C. Belton, Manager.

A. MARSTON, Secretary.

Gas Offices, Willenhall.

THE URBAN DISTRICT COUNCIL OF NEWTON-IN-MAKERFIELD.

GASHOLDER FOR SALE, AS FOLLOWS.

ONE Gasholder, 40 feet Diameter and 16 feet Deep, four Guide Columns, and Wrought-Iron Top Bracing, Chains, Pulleys, and Balance Weights complete, with two 8-inch Valves, and 8-inch Inlet and Outlet Pipes.

This Holder is in good condition, and can be seen at work at the Gas-Works, Newton-le-Willows, Lancashire.

Further Particulars may be obtained by applying at the Gas-Works to Mr. Joseph Swann, Manager.

Clerk's Office, Town Hall, Earlestown,
March 23, 1896.

GAS PLANT, BUILDINGS, AND FREEHOLD LAND AT CARSHALTON, SURREY, FOR IMMEDIATE SALE.

THE Croydon Commercial Gas and Coke Company, having discontinued the Manufacture of Gas at their Works in Wrythe Lane, Carshalton, Surrey, have the following GAS PLANT, APPARATUS, BUILDINGS, and FREEHOLD LAND FOR SALE, viz.—

Retort-House and Coal-Store complete, with Wrought-Iron Roofs, six Beds of six Round Fire-Clay Retorts in each, 18 inches diameter by 9 ft. 3 in. long, and three Beds of similar new Retorts and Arches, and three Arches, complete, ready for Retorts.

Hydraulic Mains, Fittings, &c.

Horizontal Steam-Engine, Exhauster, and Exhauster Governor, complete.

Washer (Good's Patent), 8 feet diameter, with 12-inch Connections and Valves complete.

Washer, 12-inch, with 6-inch Connections and Valves complete.

Four Purifiers, 12 feet square, with Sieves and 12-inch Connections, Lifting Apparatus and Railway for same, complete.

Station Meter, 10,000 cubic feet per hour, with 12-inch Connections.

Gasholder (Single-Lift), 80 feet by 24 feet, with Brick Tank, Columns, Inlet and Outlet Valves complete, prepared for Telescoping.

Gasholder (Single-Lift), 60 feet by 16 feet, Standards, Brick Tank, &c.

Gasholder, 35 feet by 12 feet, Standards, Brick Tank, &c.

Governor, 12 inches diameter, with 12-inch Valves and Bye-Pass complete.

Evans Photometer, Clock, Gauges, &c., complete.

House and Offices, Engine and Boiler House, Meter-House, Lobby and Store-Room, Governor-House and Testing-Room, Purifying House and Shed, Smith's Shop.

Freehold Land, 3 acres, 0 roods, 37 perches (about 2 acres not built upon).

Orders to view the Plant and Works, and Particulars of Prices the Company require for the whole or any portion of the above, can be obtained on application to

W. J. RUSSELL,
Secretary.

Offices: Katharine Street, Croydon,
March, 1896.

THE Ballymena and Harryville Gaslight Company, Limited, invite TENDERS for about 1700 Tons of best screened GAS COAL, free on Waggons at Larne Harbour; to be delivered before the 1st of November next.

Payments to be made on the first Thursday in March, 1897.

Tenders to be lodged with me on or before the 26th of March.

T. C. C. HOOD,
Secretary.

Ballymena, March 18, 1896.

GAS COAL.

THE Perth Gas Commissioners invite OFFERS for the supply of 10,000 Tons—or thereby—of SPLINT or GAS COAL, delivered at Perth (Station or Upper Harbour).

A Copy of Analysis to accompany tender.

Coal to be delivered as required between date of Contract and the 1st of May, 1897.

Offers, marked "Tender for Gas Coal," to be lodged with Wm. MacLeish, Esq., Clerk to the Commissioners, City Chambers, Perth, on or before the 1st of April next.

The Commissioners do not bind themselves to accept the lowest or any offer.

Gas-Works, Perth,
March 16, 1896.

CITY OF MANCHESTER.

TENDERS FOR CAST-IRON PIPES.

THE Gas Committee are prepared to receive, on or before Ten a.m., on Friday, the 27th inst., TENDERS for the supply of about 500 Tons of CAST-IRON PIPES of 3 inches and 4 inches diameter.

Specifications and Forms of Tender may be obtained on application to Mr. Charles Nickson, Superintendent, Gas Department, Town Hall, on payment of 10s., which will be returned on receipt of a *bonâ-fide* tender.

By order,
WM. HENRY TALBOT,
Town Clerk.

Town Hall, Manchester,
March 16, 1896.

SHEFFIELD UNITED GASLIGHT COMPANY.

TO STEEL JOIST MANUFACTURERS, GIRDER CONTRACTORS, &c.

THE Directors of this Company invite TENDERS for the supply and erection of STEEL PLATE GIRDERS and ROLLED JOISTS to form Upper Floor for Purifying-House and Floors in Liquor Tower at their Grimesthorpe Station.

The Floor is 225 feet long by 91 feet wide.

Drawings may be seen, and Specification with Bill of Quantities and Form of Tender obtained, on application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.

Sealed tenders, endorsed "Tender for Steel Girder Floor," must be delivered by post to the undersigned at the Company's Offices not later than first post on Monday, the 30th inst.

The Directors do not bind themselves to accept the lowest or any tender.

HANBURY THOMAS,
General Manager.

Commercial Street, Sheffield,
March 10, 1896.

SHEFFIELD UNITED GASLIGHT COMPANY.

TO ENGINEERS, IRONFOUNDERS, &c.

THE Directors of this Company invite TENDERS for the supply and erection of CAST-IRON COLUMNS and GIRDERS to form Floor to carry Purifiers, together with CAST-IRON LIQUOR TANK and GIRDERS to carry the same, at their Grimesthorpe Station.

The Purifier-Floor is 225 feet long by 91 feet wide; and the Liquor Tank, 33 feet long by 25 feet wide.

Drawings may be seen, and Specification with Bill of Quantities obtained, on application to Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.

Sealed tenders, endorsed "Tender for Purifier Floor and Tank," must be delivered to the undersigned at the Company's Offices (by post) not later than the first post on Monday, the 30th inst.

The Directors do not bind themselves to accept the lowest or any tender.

HANBURY THOMAS,
General Manager.

Commercial Street, Sheffield,
March 9, 1896.

SHEFFIELD UNITED GASLIGHT COMPANY.

TO IRON ROOF AND GIRDER CONTRACTORS.

THE Directors of this Company invite TENDERS for the supply and erection of an IRON ROOF, together with GIRDERS and COLUMNS to carry the same, for a Purifying-House at their Grimesthorpe Station.

The Roof is 225 feet long by 91 feet wide.

Drawings may be seen, and Specification with Bill of Quantities and Form of Tender obtained, on application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.

Sealed tenders, endorsed "Tender for Iron Roof," must be delivered to the undersigned at the Company's Offices (by post) not later than the first post on Monday, the 30th inst.

The Directors do not bind themselves to accept the lowest or any tender.

HANBURY THOMAS,
General Manager.

Commercial Street, Sheffield,
March 10, 1896.

Now Ready, Handsome Cloth, 9s. Post free,

GAS MANUFACTURE

(THE CHEMISTRY OF);

A HANDBOOK ON THE PRODUCTION, PURIFICATION, AND TESTING OF ILLUMINATING GAS, AND THE ASSAY OF THE BYE-PRODUCTS OF GAS MANUFACTURE.

For the Use of Students.

By W. J. ATKINSON BUTTERFIELD, M.A., F.C.S.,

Head Chemist, Gas-Works, Beckton, London, E.

WITH NUMEROUS ILLUSTRATIONS.

*** This work deals with the MOST MODERN DEVELOPMENTS of the subject; and the chapter treating of the BYE-PRODUCTS will be found of special interest.

London: CHARLES GRIFFIN & Co., Ltd., Exeter Street, Strand.

ARROL-FOULIS

Patent Automatic Machinery

FOR

DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,

GLASGOW.

[See Illustrated Advertisement, March 3, p. 441.]

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO EXHAUSTER MAKERS AND ENGINEERS.

THE Gas Committee are prepared to receive TENDERS for the supply and erection of an EXHAUSTER capable of passing 120,000 Cubic Feet of Gas per hour; also for an EQUILIBRIUM GOVERNOR of approved design.

It is obligatory on all Firms tendering that they shall send to the Engineer (S. Meunier), Millgate Gas-Works, Stockport, a full detail Drawing and complete Specification of the Exhauster and Governor they intend to supply ten clear days prior to the 9th of April next, but shall not state any Price thereon.

General Conditions of Contract can be obtained on application to the Engineer.

Tenders must be addressed to the Chairman of the Gas Committee, and delivered on or before Three p.m. on April 9 ensuing.

No tender will be accepted without satisfactory proof that the Firm tendering pays the Standard Rate of Wages and observes the Standard Number of Hours; and the Committee do not bind themselves to accept the lowest or any tender.

By order,
WALTER HYDE,
Town Clerk.

Stockport, March 16, 1896.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO METER MAKERS.

THE Gas Committee are prepared to receive TENDERS for the supply and erection complete of a STATION METER, fitted with Inlet and Outlet Pipes and Valves, capable of passing 125,000 cubic feet of gas per hour.

It is obligatory on all Firms tendering that they shall send to the Engineer (S. Meunier), Millgate Gas-Works, Stockport, a full detail Drawing and complete Specification of the Meter they intend to supply ten clear days prior to the 9th of April next, but shall not state any Price thereon.

General Conditions of Contract can be obtained on application to the Engineer.

Tenders must be addressed to the Chairman of the Gas Committee, and delivered on or before Three p.m. on April 9 ensuing.

No tender will be accepted without satisfactory proof that the Firm tendering pays the Standard Rate of Wages and observes the Standard Number of Hours; and the Committee do not bind themselves to accept the lowest or any tender.

By order,
WALTER HYDE,
Town Clerk.

Stockport, March 16, 1896.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO WEIGHING-MACHINE MAKERS.

THE Gas Committee are prepared to receive TENDERS for the supply and erection of a 10-Ton WEIGHBRIDGE at their Portwood Works.

It is obligatory on all Firms tendering that they shall send to the Engineer (S. Meunier), Millgate Gas-Works, Stockport, a full detail Drawing and complete Specification of the Machine they intend to supply ten clear days prior to the 9th of April next, but shall not state any Price thereon.

General Conditions of Contract and Particulars can be obtained on application to the Engineer.

Tenders must be addressed to the Chairman of the Gas Committee, and delivered on or before Three p.m. on April 9 ensuing.

No tender will be accepted without satisfactory proof that the Firm tendering pays the Standard Rate of Wages and observes the Standard Number of Hours; and the Committee do not bind themselves to accept the lowest or any tender.

By order,
WALTER HYDE,
Town Clerk.

Stockport, March 16, 1896.

Fcap. 4to, Cloth, price 7s. 6d., post free.

Practical Photometry.

By William Joseph Dibdin, F.I.C., F.C.S.

LONDON: Walter King, 11, Bolt Court, Fleet St., E.C.

BISHOP AUCKLAND DISTRICT GAS COMPANY.

THE Directors of the Bishop Auckland District Gas Company are prepared to receive TENDERS for the construction and erection of a SINGLE-LIFT GASHOLDER, 96 feet diameter by 26 ft. 3 in. deep, upon their Gas-Works Premises at Bishop Auckland.

Plans and Specification may be seen at the Company's Offices, and any further Information obtained from the undersigned.

Tenders, endorsed "Gasholder," to be lodged with me not later than Ten a.m. of the 1st day of April, 1896.

By order,
W. E. WALTON,
Secretary.

Gas Offices, Bishop Auckland.

SKIPTON GAS COMPANY.

THE Directors of this Company are prepared to receive TENDERS for the supply of 6000 Tons of good GAS COAL, to be delivered in such quantities and at such times as may be required during Twelve Months ending June 30, 1897.

Quotations to specify if Coal is screened or unscreened, and price delivered, free on rail, at Skipton Station, or free on Boat alongside the Company's Works.

Sealed tenders, endorsed "Tender for Coal," to be sent to the undersigned not later than April 6 next.

The Directors do not bind themselves to accept the lowest or any tender.

J. HAIGH,
Secretary.

Gas Office, Skipton,
March 13, 1896.

GASHOLDER.

THE Urban District Council of Hindley are prepared to receive TENDERS for a THREE-LIFT GASHOLDER WITH COLUMNS, and also ONE WITHOUT COLUMNS, for a Tank 85 feet diameter by 24 feet deep.

Makers to submit Plans, Specifications, and Prices, and state how soon they can deliver.

Further Particulars can be known on application to Mr. Dickinson, Gas and Water Manager, Hindley.

Tenders, sealed and endorsed "Gasholder," to be lodged with the undersigned not later than Monday, April 13, 1896.

The lowest or any tender not necessarily accepted; and parties tendering must do so at their own cost.

By order,
STEPHEN HOLT,
Clerk to the Council.

Offices: Cross Street, Hindley,
March 19, 1896.

TYLDESLEY URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas and Water Committee invite TENDERS as follows:—

(*a*) For the construction of two Through Benches of RETORTS, with GENERATOR FURNACES, including Retorts, Bricks, Tiles, Blocks, Buck-Staves, Girders, and Floor-Plates.

(*b*) Twenty-four (24) Patent Faced MOUTHPIECES.

Particulars may be obtained from the Gas Engineer, Council Office, Tyldesley.

Tenders, sealed and endorsed "Tenders for Retorts, &c.," or "Tender for Retort Mouthpieces," as the case may be, to be delivered to the undersigned on or before the 7th of April next ensuing.

The lowest or any tender not necessarily accepted.

FRANK T. WRIGHT,
Clerk to the Council.

Tyldesley, March 19, 1896.

BOROUGH OF MACCLESFIELD.

THE Gas Committee are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR made at their Works during the Twelve Months commencing the 1st day of May next.

Tenders, for the Tar or Liquor separately, to be sent in not later than Saturday, the 11th of April, 1896, addressed to the Chairman of the Gas Committee, Town Hall, Macclesfield, and endorsed "Tender for Tar, &c."

For Conditions, apply to Mr. Newbigging, Engineer, Gas-Works, Macclesfield.

The Committee reserve to themselves the right of accepting any tender for the Tar or Liquor separately.

The highest or any tender not necessarily accepted.

W. FREDK. TAYLOR,
Town Clerk.

March 9, 1896.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR PIPES.

THE Directors of this Company invite TENDERS for the supply of 560 yards of 12-inch, 900 yards of 4-inch, and 600 yards of 3-inch CAST-IRON GAS MAINS.

Further Particulars may be obtained from the undersigned, by whom tenders will be received until Tuesday, the 31st inst.

JAMES BRADDOCK,
Manager and Secretary.

Gas-Works, Radcliffe,
March 17, 1896.

GAS-WORKS FOR SALE.

THE undersigned is prepared to receive TENDERS for the purchase of the GAS-WORKS at Carrick-on-Shannon, consisting of Buildings, Gasholder, Retorts, Purifiers, Condenser, Scrubber, Station Meter, Mains, Services, and Meters.

Intending Purchasers will also state whether they would be prepared to continue the Manufacture of Gas, and mention the Price at which they would do so. Such Price, however, is not to exceed that now charged the Inhabitants for Gas and Meter Rent.

Tenders will be received not later than Friday, May 1, 1896, by the Liquidator, 85, Capel Street, Dublin, who will be prepared to give any further Information that may be required.

HENRY WIGHAM,
Liquidator.

85, Capel Street, Dublin.

HARROW AND STANMORE GAS COMPANY.

NOTICE is Hereby Given, that the Directors of the above Company intend to offer for SALE by PUBLIC AUCTION, at the Mart, Tokenhouse Yard, in the City of London, on Monday, the 27th day of April next, at Two o'clock in the afternoon precisely, £5000 of New "C" Capital, in Shares of £10 each, in Lots of ten Shares each, to be issued under the Powers of the Harrow and Stanmore Gas Act, 1894.

By order,
JAMES LAWRENCE CHAPMAN,
Secretary.

Dated this 12th day of March, 1896.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

HUNTER'S

OXIDE OF IRON.

JAMES HUNTER, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "HUNTER, PORT GLASGOW."

Established 1872.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

TELEGRAMS: "ATLAS, SHEFFIELD."

NOTICE.

Whereas it has come to the knowledge of the INCANDESCENT GAS-LIGHT COMPANY, Limited, of Palmer Street, Westminster, that a Company called the Meteor Incandescent Gas-Light Company, Limited, a firm known as Putz and Co., and a Company known as the Evening Sunlight Incandescent Light Company or the New Incandescent Light Company, are selling, and are offering for sale, forms of Incandescent Gas-Lights called respectively the "Meteor," the "Champion," and the "Evening Sunlight,"

THIS IS TO GIVE NOTICE, THAT THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, will commence ACTIONS FOR INFRINGEMENTS OF THEIR PATENTS against all persons found dealing in any manner with the said "Meteor," "Champion," or "Evening Sunlight" Incandescent Gas-Lights, which are all constructed in Infringement of the Patent of the Incandescent Gas-Light Company, Limited.

The validity of the Company's Patent has been certified by the Hon. Mr. Justice Romer.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

> "The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

> The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

WARNING.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

WHEREAS, it has been brought to the notice of the INCANDESCENT GAS-LIGHT COMPANY, LIMITED, THAT DIVERS FIRMS UPON THE CONTINENT OF EUROPE are Manufacturing Incandescent Gas-Mantles, and are sending the same into this Country, and are advertising for Agents to push the sale of these Mantles,

THIS IS TO GIVE NOTICE, THAT ALL SUCH MANTLES ARE INFRINGEMENTS OF THE COMPANY'S PATENT, and that the Company will take proceedings for Infringement against all persons purchasing or using any of such Incandescent Gas-Mantles. THE COMPANY OWN THE MASTER PATENTS in this Country for the manufacture of Incandescent Gas-Mantles, and the validity of such Patents has already been certified by the Honourable Mr. Justice Romer, and the Company will enforce their Patent Rights against all Infringers.

FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.
11, Victoria Street, Westminster.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an Action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.
Nov. 30, 1895.

LOW MOOR BLACK BED GAS COAL.

YIELD OF GAS PER TON - 10,375 CUBIC FEET.
ILLUMINATING POWER - 17·50 SPERM CANDLES.
COKE - - - - - - - - 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to
GEORGE & JOHN HAIGH,
RAVENS LODGE AND CONYERS' COLLIERIES,
DEWSBURY.

A TRIAL IS RESPECTFULLY SOLICITED.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . $13\frac{1}{2}$ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor $94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

COKE-BREAKERS,

PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . . 10,500 Cubic Feet.
Illuminating Power . . 16·9 Candles.
Coke . . . . . 66·7 Coke.
Sulphur . . . . . 0·86 Sulphur.
Ash . . . . . 2·04 Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the
HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

Telegrams, "INCLINED, LONDON."

Little & Graham Ltd.

THE INCLINED RETORT SPECIALISTS.

SEE OUR LATEST PATENTS

THE SUCCESS OF THE SYSTEM.

GILBERT LITTLE

MAURICE GRAHAM, A.M.I.C.E

ENGINEERS CONTRACTORS AND **Carbonizing Specialists.**

3 & 4, LIME STREET SQ.
LONDON, E.C

RIMBAULT

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

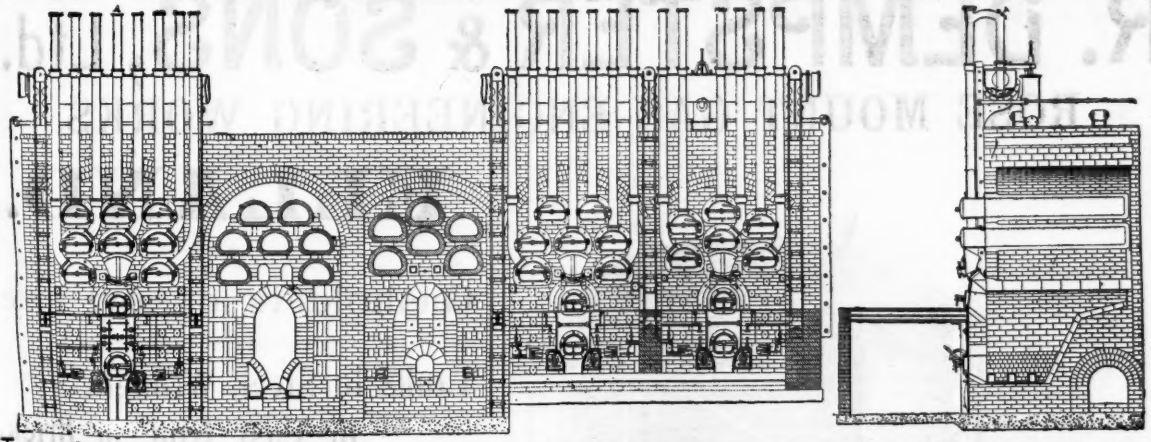
SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
12, JOHN STREET, ADELPHI, LONDON, W.C.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
Further Information and Pamphlets from Principal Agent.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 81, OLD BROAD ST., E.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works
(also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

THOMAS TURTON
AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

Price 21s., Post Free,
PRECEDENTS IN
PRIVATE BILL LEGISLATION
AFFECTING GAS AND WATER UNDERTAKINGS, 1879-90.
Compiled by E. H. STEVENSON & E. K. BURSTAL.
London: WALTER KING, 11, Bolt Court, Fleet St., E.C.

W. E. SANDER,
COMMISSION AGENT, BERLIN, 41, FRIEDRICH STR.

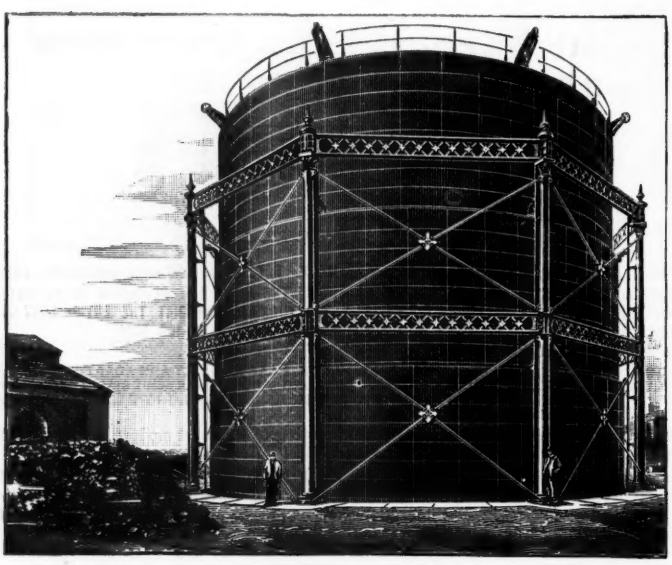
SPECIALITIES: Incandescent Lamp Burners and Mantles (with or without electric lighting from any distance, by button from the wall, etc.).

INCANDESCENT SPIRIT LAMPS.
Electro-technical Ware of all kinds.
IMPORT and EXPORT.

STOURBRIDGE
RETORTS AND FIRE-BRICKS.
BEST QUALITY.
KING BROTHERS, STOURBRIDGE.
[See Illustrated Advertisement, March 3, p. 484.]

OXIDE OF IRON.
NATURAL BOG ORE FROM OWN MINES.
Samples and Prices on application.
WM. H. MÜLLER & CO.,
81, PALMERSTON BUILDINGS, LONDON, E.C.
TRADE MARK: "Compascum." Telegraphic Address: "FERRUM."

R. DEMPSTER & SONS, Ltd.,
ROSE MOUNT GAS ENGINEERING WORKS,
ELLAND.



TELESCOPIC HOLDER CONVERTED BY US INTO A THREE-LIFT.

Gasholders of any size.

Tanks in Steel, Wrought or Cast Iron, or Brick.

SCRUBBERS & PURIFIERS.

Rotary and Reciprocating Exhausters.

Generator and Regenerator Furnaces and Retort Work of every description.

CONTRACTORS FOR EVERY DESCRIPTION OF
GAS PLANT AND CONSTRUCTIONAL IRONWORK.
ENQUIRIES SOLICITED.

CLAYTON SON & Co., LTD,

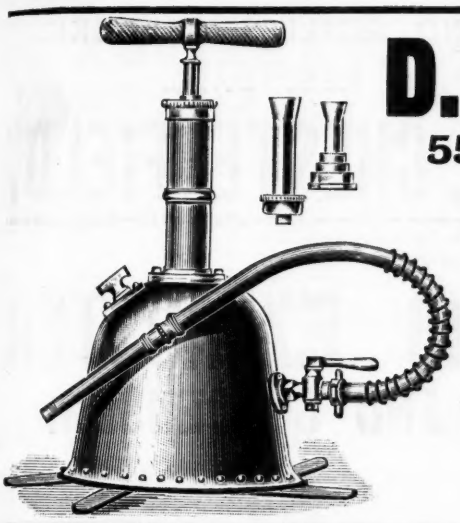
MAKERS OF LEEDS

LARGEST GASHOLDER IN WORLD

ALSO THE LARGEST METAL TANK THE

See Advertisement last week, also next week

MAKERS OF RETORT-LIDS OF ALL FORMS & SHAPES BY SPECIAL HYDRAULIC MACHINERY.



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55 & 56, High Holborn, London.

GAS SERVICE CLEANSERS.

LAMP TORCHES.

DRY GAS-METER MAKERS.

WROUGHT-IRON TUBES & FITTINGS.

STREET LAMPS & POSTS.

PRICE LISTS ON APPLICATION.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

Over 50 Maxim Patent Carburettors have now been fixed, capable of enriching

650,000,000

CUBIC FEET OF GAS PER DAY.

Among the Companies supplied are The Gaslight and Coke Company, the South Metropolitan Gas Company, Birmingham Corporation, Manchester Corporation, Rochdale Corporation, Bristol Gas Company, and many other Works, both large and small, where they have been working in some instances for the past FOUR YEARS.

More Gas and saleable Coke per ton of Coal Carbonized is produced; saving Capital, Labour, Fuel, Wear and Tear, &c.

The Enrichment is INSTANTANEOUS and PERMANENT.

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

SOLE AGENTS FOR REDWOOD & CLOWES' INFLAMMABLE VAPOUR & GAS DETECTORS.

Dealers in Carburine and all other Naphthas for the Enrichment of Gas.

FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

ESTABLISHED 1862.

TRADE MARK.

NEW GAS PLANT CEMENT

For all Joints in connection with

SULPHATE PLANT. OIL-GAS PLANT. GAS. TAR. AMMONIA.

SAMPLES ON APPLICATION.

SPECIAL PAINTS FOR GAS-WORKS.

Telegrams "Enamel." Nat. Tel. 1759.

John E. Williams & Co., *Victoria Paint Works,* **Manchester.**

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.,
8 Lombard Street,
NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

HEATHCOTE GAS COAL.

RICH IN ILLUMINATING POWER AND YIELD OF GAS.

ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.

MAINTAINS A HIGH STANDARD IN RESIDUALS.

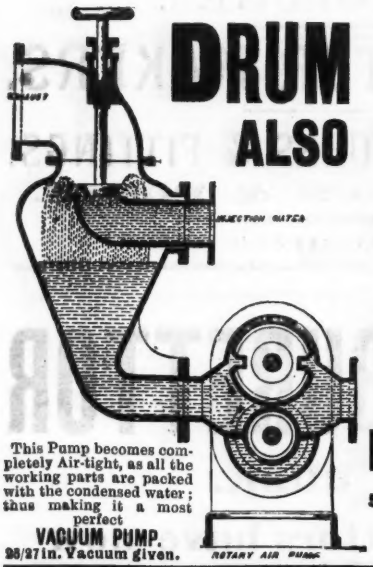
THE GRASSMOOR Co., Ld., CHESTERFIELD.

"The Force of the Piston Pump with the Capacity of the Centrifugal combined."

JOHNSON'S PATENT

DRUM PUMP AND EXHAUSTER

ALSO VACUUM PUMP AND CONDENSER.



This Pump becomes completely Air-tight, as all the working parts are packed with the condensed water; thus making it a most perfect

VACUUM PUMP.

26/27 in. Vacuum given.

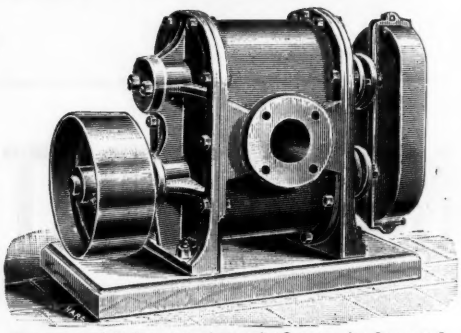
No Priming, Valves, or Frictional Working Parts.

The Pump of the future for quickly and economically moving large Bodies of Water, Semi-fluid, &c.

DRUM ENGINEERING Co.

55, ATHOL ROAD,

BRADFORD.



Blowers and Exhausters guaranteed, even at a slow speed, to give a working pressure of 3 lbs. and upwards, and this without losing power by creating frictional Heat.

GASEOUS FIRING A SPECIALTY.

Telegraphic Address:
"DRAKESON, HALIFAX."

GAS ENGINEERS.
RETORT SETTERS.
IRONFOUNDERS.

SOLE MAKERS OF

"MITTON'S"
PATENT SELF
-SEALING-
RETORT-LID.

JONAS DRAKE & SON

SOLE AGENTS
For
"HISLOP'S"
PATENT REGENERATIVE
FURNACES.
FOR ENGLAND, WALES & ABROAD.

OVENDEN, HALIFAX.

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60. QUEEN VICTORIA ST., E.C.

Telephone No. 43.
HALIFAX EXCHANGE.

CONTRACTORS.
FURNACE BUILDERS.
&c. &c.

SOLE MAKERS OF

"SETTLE'S"
PATENT COMBINED
SEAL-REGULATING
FLUSH-VALVE.

ALEX. C. HUMPHREYS, M.Inst.C.E. A. G. GLASGOW, M.E.

MESSRS. HUMPHREYS & GLASGOW

Have constructed their EUROPEAN type of

CARBURETTED WATER-GAS PLANT

At the following Gas-Works:—

Copenhagen	700,000 Cub. Ft.	Liverpool	2,500,000 Cub. Ft.
Belfast	1,700,000 ,,	Tottenham	600,000 ,,
Glasgow	300,000 ,,	Brighton	1,250,000 ,,
Brussels	700,000 ,,	Bath	1,000,000 ,,
Santiago	400,000 ,,	New York	1,000,000 ,,
Swansea	700,000 ,,	Newburgh, N.Y.	350,000 ,,

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Manchester	3,000,000 Cub. Ft.
Preston	1,500,000 ,,	Brussels (Second Contract)	700,000 ,,
Southport	750,000 ,,	St. Joseph, Mo.	750,000 ,,
Tottenham (Second Contract)	750,000 ,,	Holyoke, Mass.	500,000 ,,

In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

9, Victoria Street, London, S.W. Telegrams: "EPISTOLARY, LONDON." *United States Office, 64, Broadway, New York.*

R. & A. MAIN,

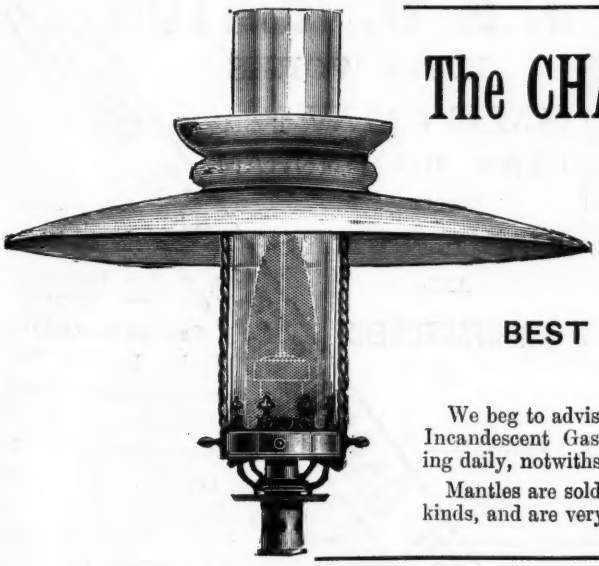
GAS COOKING AND HEATING STOVES,

92, ALDERSGATE STREET, KINNING PARK,

LONDON, E.C., & GLASGOW.

Special Notice

TO GAS COMPANIES AND DISTRICT COUNCILS, ARCHITECTS, BUILDERS, AND CONTRACTORS.



The CHAMPION INCANDESCENT GAS-BURNER.

BEST LIGHT AT LOWEST COST.

We beg to advise our numerous friends and customers that the Champion Incandescent Gas-Burner still holds the field, and that our sales are increasing daily, notwithstanding the threats of our competitors.

Mantles are sold in any quantity without restriction for use of particular kinds, and are very durable.

F. J. PUTZ & CO.,

Temporary Premises: 16 & 17, GREAT ST. HELENS, LONDON, E.C.

Telegraphic Address: "PUTZ, LONDON."

Several large Show-Rooms will shortly be opened in different Districts. All Agents and Buyers are fully indemnified against Law Proceedings. A few more Agents wanted in several Districts.

BOWENS' Ltd. Successors,

STOURBRIDGE.

MANUFACTURERS OF

BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.

Established 1860.

WILLIAM INGHAM & SONS,

Incorporated with the Leeds Fire-Clay Company, Ltd.,

WORTLEY FIRE-CLAY WORKS,

Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

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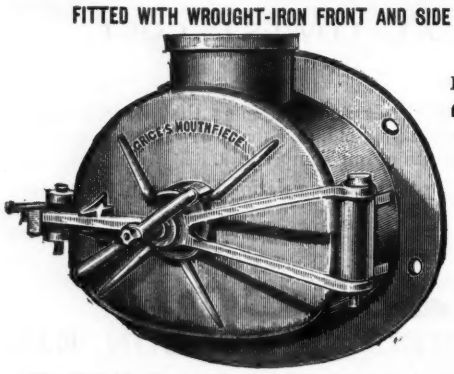

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Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

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Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

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Over 292,000,000 Cubic Feet of Gas per Day is passing through about 550 of these Machines.

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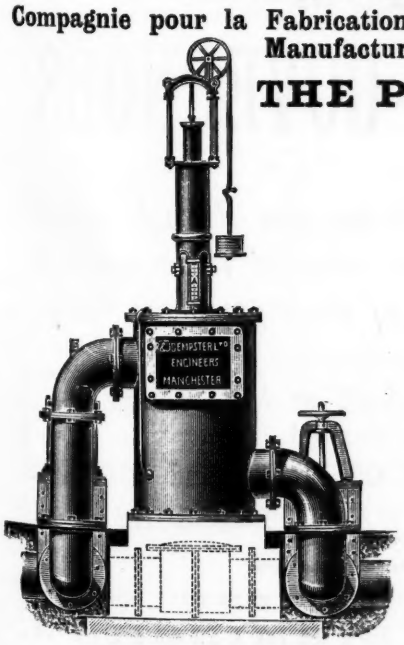
THE PELOUZE & AUDOUIN CONDENSER,

According to P. AUDOUIN'S LATEST PATENTS.



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This Apparatus is in very general use in most of the Gas-Works on the Continent and in America; over **550** being in use in different parts of the World for condensing and arresting all Tar Particles and Vapours from the Gases from Coal, Oil, and Wood.

The large number in use is sufficient proof of its utility. By the almost complete elimination of Tar, which is effected to the extent of 99·7 per cent., it facilitates Purification in the Purifiers, by preventing the clogging or obstruction of the Purifying Materials, which, in consequence, last much longer; thus effecting a Saving both in Materials and Labour.

So effective is this Apparatus that a piece of white paper placed over a Test-Tap on the Inlet of the Machine is immediately covered with Tar, whilst on the Outlet the white paper remains perfectly clean.

The Machines are made in the following sizes, for Works producing per 24 hours—

	Cubic Feet.		Cubic Feet.
0	35,000	5	500,000
1	70,000	6	700,000
2	140,000	7	1,240,000
3	210,000	8	1,750,000
4	350,000	For larger Makes, two Machines are recommended.	

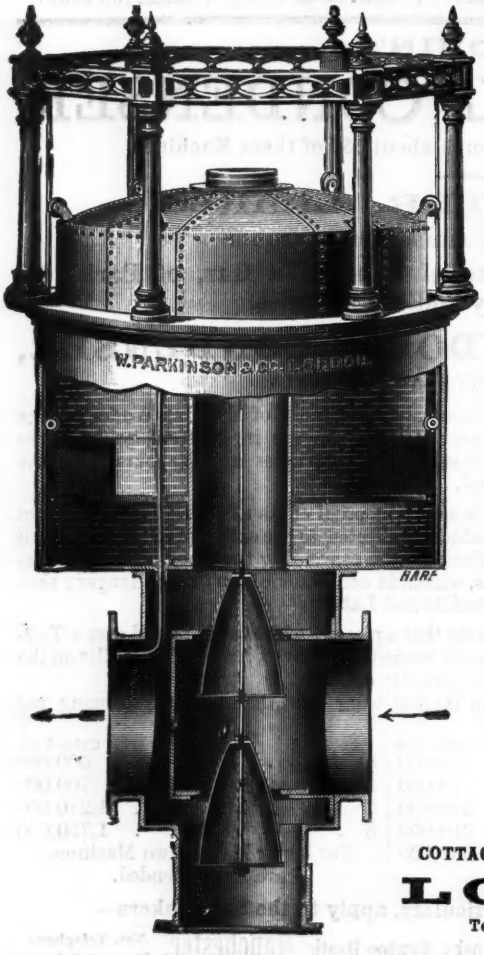
For Prices and further Particulars, apply to the Sole Makers—

Telegraphic Address: "SCRUBBER, MANCHESTER." **R. & J. Dempster, Ld., Gas Plant Works, Newton Heath, Manchester.** Nat. Telephone Nos. 2296 & 84.

W. PARKINSON & CO.

SQUARE STATION METERS.

All the Meters (which number 14) at the Beckton Station of THE GASLIGHT AND COKE COMPANY have been erected by the above Firm.



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[See also Advt. p. 614.

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